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Calibration of Anemometers

By A. H. ANDERSON

The data given in this article will show that the method of calibrating anemometers by swinging in a short radius is quite erroneous.

The apparatus shown in Fig. 1 indicates the manner of mounting the anemometer on an arm 18 in. long. The trigger of the anemometer is connected to the bent lever at the center of rotation by which means the counting mechanism may be engaged or disconnected.

Fig. 2 shows the anemometer mounted at the end of an arm 23½ ft. long. One end of the arm is centered on the post of a heavy iron tripod. The other end is supported by a rubber-tired wheel 10 in. in diameter. The trigger is operated by two cords A and B which are loosely supported by two rings near the center of rotation.

Cord A slips over the pulley C and thence to the trigger while cord B runs to the trigger direct. The operator stands near the tripod and by means of the cords the counting mechanism of the anemometer is engaged or disengaged while the arm is in rotation. Such a test as this must be conducted in a large room with a very smooth floor, and it is also necessary that the air in the room be undisturbed by drafts. It is possible to rotate the arm at any rate from exceedingly slow to 1000 ft. per minute. The method of making a test is to make a mark on the floor and start the arm around its path at as nearly the right speed as can be judged by eye,

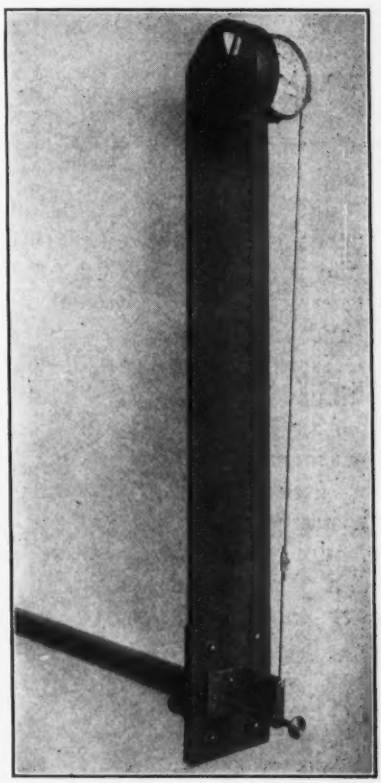


FIG. 1—METHOD OF MOUNTING ANEMOMETER ON ARM 18 IN. LONG.

the counting mechanism of the anemometer being disengaged, and at the instant the wheel passes the mark on the floor

the time is noted and the cord for engaging the anemometer is pulled. One or two complete revolutions by the arm should be made at a uniform speed, the counting mechanism of the anemometer being disengaged when the wheel again passes the starting mark on the floor, and the time noted at the same instant. The circumference of the circle described by the center of the anemometer

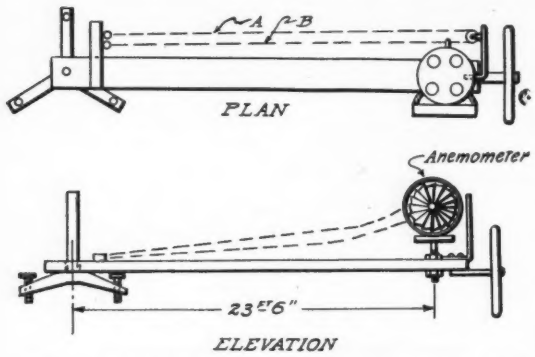


FIG. 2—ANEMOMETER MOUNTED ON ARM 23½ FT. LONG.

is 147.7 ft., and it will be found the anemometer indicates a little more or less than that amount. Similar runs are made at different rates of rotation.

At speeds greater than 1,000 ft. per minute the rotation of the long arm becomes too rapid for convenient manipulation, and the anemometer is now dismounted from the arm and the calibration continued by means of the pitot tube. A blast of air is provided from a centrifugal fan through a round pipe 24 in. diameter (see Fig. 3). The anemometer is mounted in the blast at the outlet of the pipe and close beside it is mounted a pitot tube which is connected by rubber tubing to a sensitive gauge

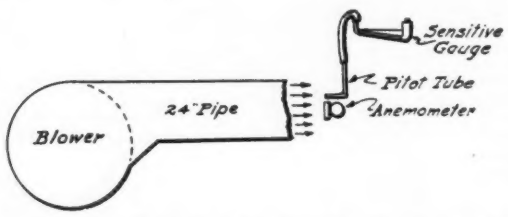


FIG. 3—ARRANGEMENT OF AIR BLAST WITH LOCATION OF PITOT TUBE AND ANEMOMETER.

reading in inches of water. The blast of air can be varied by changing the speed of the fan and beginning with an air velocity of 1,000 ft. per minute the reading of the anemometer is noted for the period of a minute and the indication of the differential gauge is read.

Similar runs are made at suitable intervals up to 4,000 ft. per minute. The following table gives the velocities in feet per minute corresponding to various pitot tube velocity heads. The velocities obtained from the pitot tube indications are the correct velocities.

TABLE 1.

Temperature of Air 80° F.

Velocity Pressure Inches	Feet per Minute	Velocity Pressure Inches	Feet per Minute
0.01	409	0.96	4008
0.02	579	0.97	4029
0.03	710	0.98	4050
0.04	818	0.99	4070
0.05	914	1.00	4090
0.06	1000	1.01	4110
0.07	1080	1.02	4130
0.08	1155	1.03	4150
0.09	1227	1.04	4170
0.10	1295	1.05	4190
0.11	1355	1.06	4210
0.12	1418	1.07	4230
0.13	1475	1.08	4250
0.14	1530	1.09	4270
0.15	1585	1.10	4290
0.16	1635	1.11	4308
0.17	1690	1.12	4327
0.18	1735	1.13	4345
0.19	1785	1.14	4364
0.20	1830	1.15	4382
0.21	1875	1.16	4401
0.22	1920	1.17	4419
0.23	1960	1.18	4438
0.24	2005	1.19	4456
0.25	2050	1.20	4475
0.26	2090	1.21	4493
0.27	2125	1.22	4512
0.28	2160	1.23	4530
0.29	2200	1.24	4549
0.30	2240	1.25	4567
0.31	2275	1.26	4586
0.32	2310	1.27	4604
0.33	2350	1.28	4623
0.34	2390	1.29	4641
0.35	2420	1.30	4660
0.36	2455	1.31	4678
0.37	2485	1.32	4696
0.38	2520	1.33	4714
0.39	2550	1.34	4732
0.40	2590	1.35	4750
0.41	2620	1.36	4768
0.42	2650	1.37	4786
0.43	2680	1.38	4804
0.44	2710	1.39	4822
0.45	2740	1.40	4840
0.46	2770	1.41	4857
0.47	2800	1.42	4874
0.48	2830	1.43	4891
0.49	2865	1.44	4908
0.50	2890	1.45	4925
0.51	2920	1.46	4942
0.52	2950	1.47	4959
0.53	2980	1.48	4976
0.54	3000	1.49	4993
0.55	3030	1.50	5010
0.56	3060	1.60	5180
0.57	3090	1.70	5330
0.58	3115	1.80	5490
0.59	3140	1.90	5640
0.60	3170	2.00	5790
0.61	3200	2.10	5930

0.62	3225	2.20	6080
0.63	3250	2.30	6210
0.64	3275	2.40	6330
0.65	3300	**2.50**	6480
0.66	3325	2.60	6600
0.67	3350	2.70	6720
0.68	3375	2.80	6850
0.69	3400	2.90	6970
0.70	3425	3.00	7090
0.71	3450	3.10	7200
0.72	3475	3.20	7320
0.73	3500	3.30	7430
0.74	3525	3.40	7540
0.75	3550	**3.50**	7660
0.76	3570	3.60	7760
0.77	3590	3.70	7870
0.78	3615	3.80	7970
0.79	3640	3.90	8070
0.80	3660	4.00	8180
0.81	3680	4.10	8280
0.82	3700	4.20	8400
0.83	3720	4.30	8480
0.84	3740	4.40	8580
0.85	3765	**4.50**	8670
0.86	3790	4.60	8770
0.87	3810	4.70	8870
0.88	3835	4.80	8970
0.89	3860	4.90	9055
0.90	3880	5.00	9140
0.91	3905	5.10	9225
0.92	3925	5.20	9310
0.93	3946	5.30	9395
0.94	3967	5.40	9480
0.95	3988		

TABLE 2

If temperature is other than 80° F. multiply velocities in Table 1 by constants corresponding to various temperatures:

50° F.	0.972
60° F.	0.980
70° F.	0.990
80° F.	1.000
90° F.	1.010
100° F.	1.025
110° F.	1.038

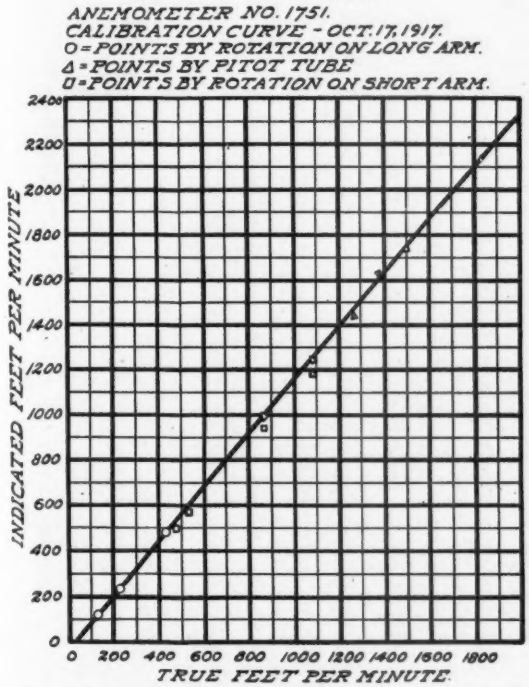

ANEMOMETER NO. 1751.
CALIBRATION CURVE - OCT. 17, 1917.
O = POINTS BY ROTATION ON LONG ARM.
Δ = POINTS BY PITOT TUBE
□ = POINTS BY ROTATION ON SHORT ARM.
INDICATED FEET PER MINUTE
TRUE FEET PER MINUTE
0 200 400 600 800 1000 1200 1400 1600 1800
2400 2200 2000 1800 1600 1400 1200 1000 800 600 400 200 0

FIG. 4—RELATION BETWEEN TRUE VELOCITIES AND INDICATED VELOCITIES OF ANEMOMETER.

Fig. 4 shows the relation between the true velocities and the indicated velocities of the anemometer. The points in the test made with the long arm are indicated by small circles, which the points obtained by pitot tube are shown by crosses. The points obtained by the short arm are shown by small squares and it will be seen that there is a discrepancy between the short arm and the long arm results. The indications ob-

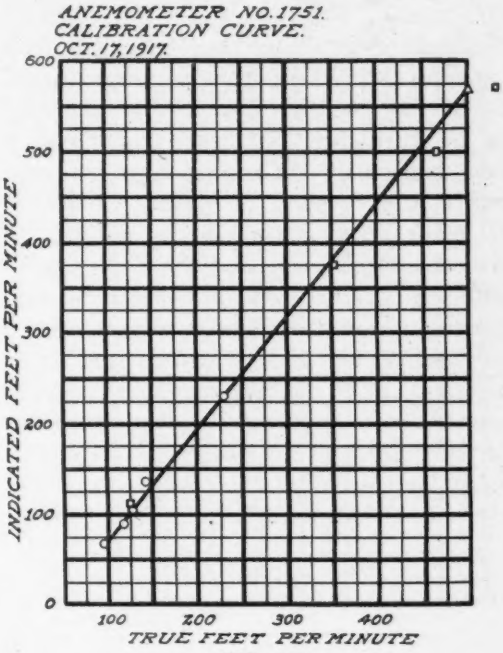


FIG. 5.

tained by moving the anemometer in a straight line, and it is to be expected that the short arm would give indications which are slower than with the long arm for equal peripheral velocities.

From the calibration test the following table of corrections may be drawn up:

Table 3

Anemometer Indication	Add or Subtract
50	+ 40
100	+ 25
150	+ 10
200	+ 5
250	— 5
300	— 15
350	— 25
400	— 35
450	— 40
500	— 50
600	— 70
800	— 100
1000	— 130
1200	— 160
1400	— 190
1600	— 220
1800	— 250
2000	— 280

Fig. 5 is the part of the curve from 0 to 500 ft. per minute drawn to a large scale.

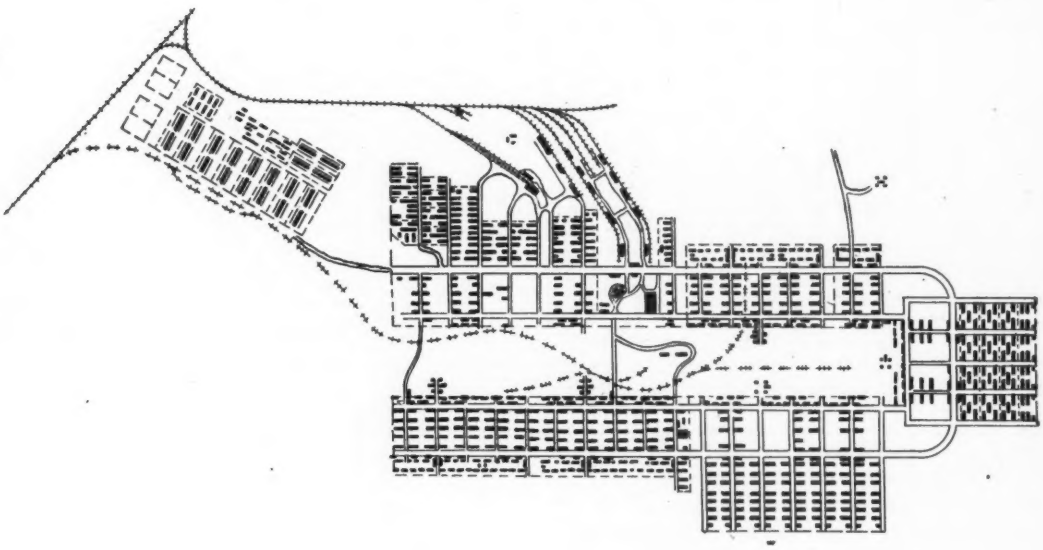
The Heating Equipment for a Great Military Camp

Details of the Installation at a Typical Cantonment — Camp Upton, Yaphank, L. I.

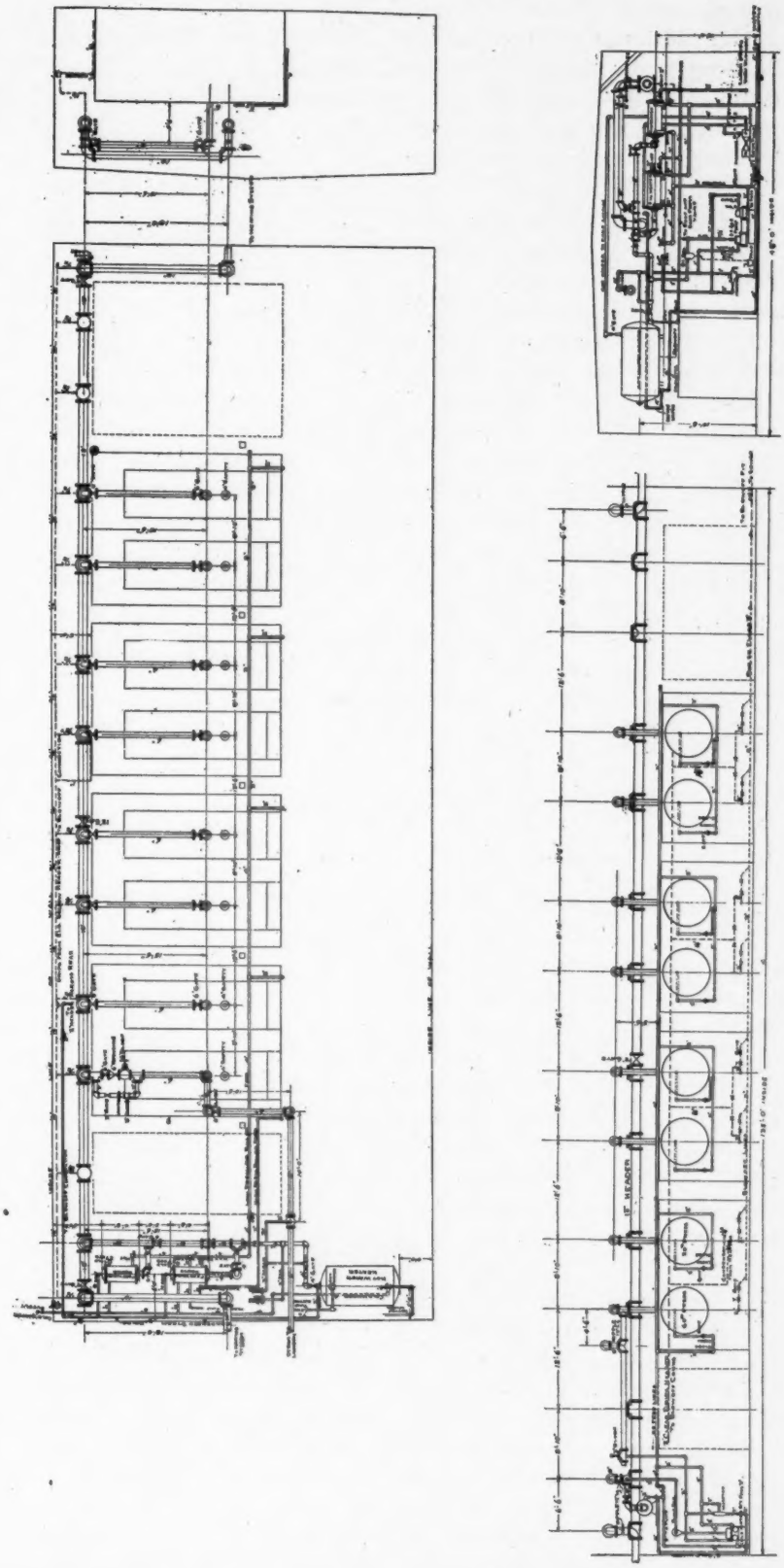
No one who has not visited one of the great army cantonments that have been constructed for the new United States National Army can have any adequate conception of the extent of these camps or of the masses of materials that had to be furnished for their construction and equipment—in many cases on short notice and in spite of serious obstacles. It will always remain a tribute to American efficiency that the camps were sufficiently advanced in construction to permit the drafted men to report on the date scheduled and to march into their quarters. To the public generally, and especially to engineers, the development of the plans and the design of the equipment have been matters of lively interest, but, due at first to the naturally reticent policy of the government and, later, to the overwhelming rush of work in completing the cantonments on time, it has not been possible until now to present a full description of the camps.

UNIFORM GENERAL PLAN FOR ALL CANTONMENTS.

Although the equipment of the various cantonments differs in many respects, in all basic features the arrangements are the same. The basic plans for the heating of all the cantonments were prepared in Washington under the direction of General I. W. Littell, constructing quartermaster, Major Gunby having charge of the engineering features and Captain Tripp having charge



GENERAL PLAN OF CAMP UPTON, YAPHANK, L. I., N. Y.
(1200 Acres Are Included Within the Cantonment Limits.)



BASE HOSPITAL BOILER HOUSE, CAMP UPTON.

of the heating, under Major Gunby's direction. For the most part variations were made from these plans only where local conditions made it necessary.

At Camp Upton, located at Yaphank, L. I., New York, the entire construction work was under the direction of Major O. K. Myers, constructing quartermaster. The contract for the construction and equipment was awarded to the Thompson-Starrett Company, William H. Driscoll, of that company, having direct charge of the water supply, plumbing and electrical work. Walter S. Timmis, of New York, was retained as consulting engineer for the heating.

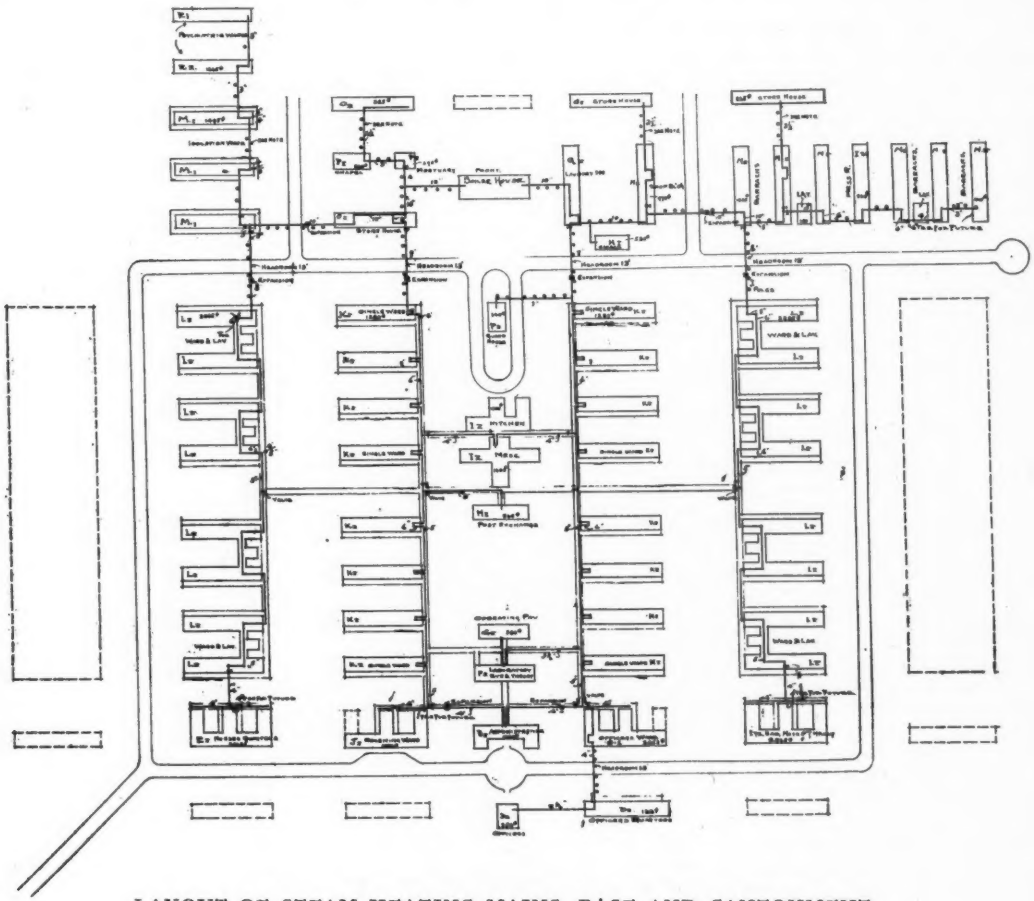
For the present, at least, all of the barracks are heated by room heaters and stoves. There is, however, a great number of buildings which are supplied with steam heat. The following list, showing the buildings heated by steam and those heated by stoves, will give some indication of the vastness of the camp:

BUILDINGS STEAM HEATED

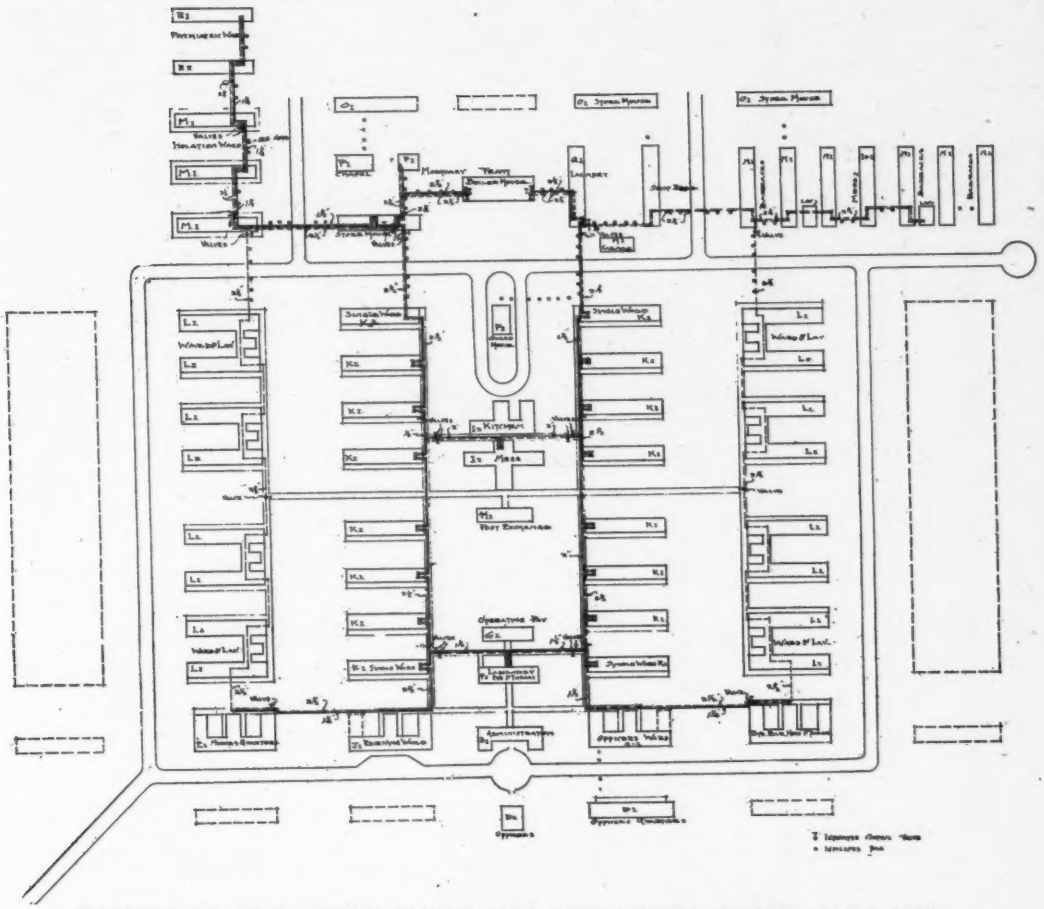
108 Officers quarters
12 Medical Buildings
2 Fire Houses
1 Bakery
1 Laundry
2 Residences
2 Administration Bldgs.
60 Hospital Buildings

BUILDINGS HEATED BY STOVES

255 Lavatories
359 Barracks
40 Guardhouses



LAYOUT OF STEAM HEATING MAINS, BASE AND CANTONMENT HOSPITAL, CAMP UPTON.



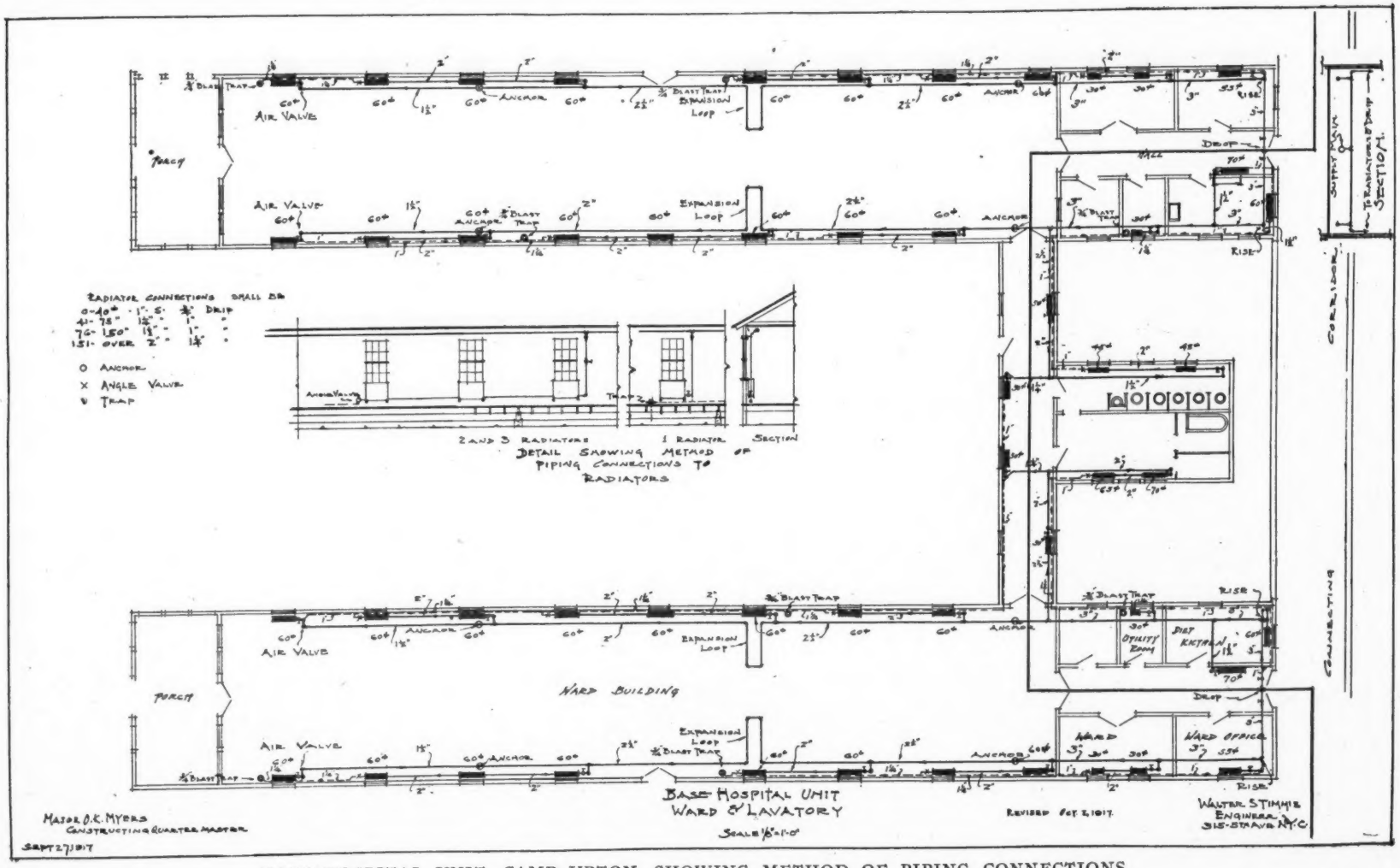
LAYOUT OF LIVE STEAM MAINS AND HOT WATER PIPING, BASE AND CANTONMENT HOSPITAL, CAMP UPTON

12 Post Exchanges
17 Administration buildings
1 Post Office
1 Telephone & Telegraph office
23 Mess buildings
3 Offices
4 Operating Rooms
2 Warehouses
4 Utility buildings
40 Barracks for Civilians

THE HOSPITAL GROUP.

Included in the hospital group are sixty buildings occupying a space of about 100 acres. These buildings are all heated from a central heating station, equipped with eight 150-H.P. boilers, with provision for three additional boilers of the same size. Direct radiation is used throughout in the form of two- and three-column cast-iron radiators. Every effort was made to simplify the installation of the system and the illustrations show a simple expedient used so that the returns could be carried underneath the radiators. Stands for the radiators were made of uniform type and in great numbers. These stands are simple wooden frames from 8 to 10 in. high and were found very serviceable.

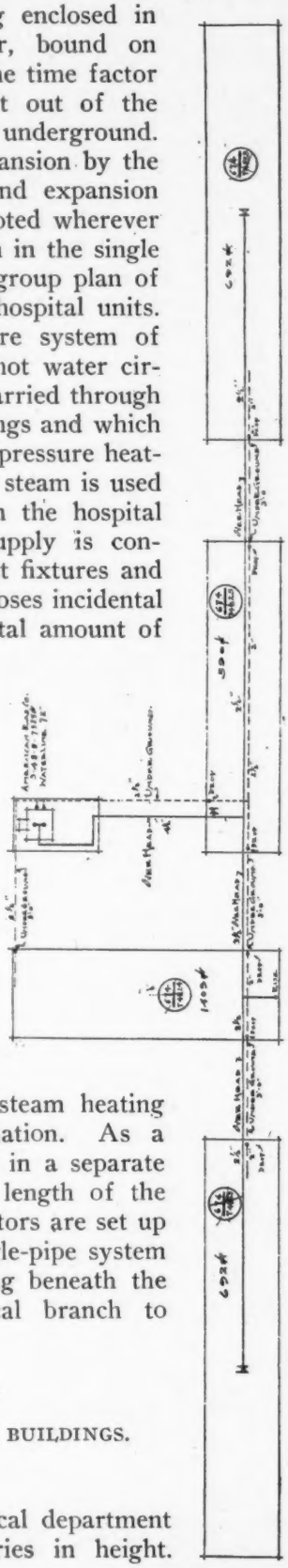
The returns from the radiators are trapped and run to dry wells outside the various buildings. The distributing piping is carried overhead and for the most part in corridors which are enclosed and which connect the various buildings. Where the distributing piping is exposed to the weather some protection is afforded by a covering of 1-in. air cell, over which is placed a layer of 1-in.



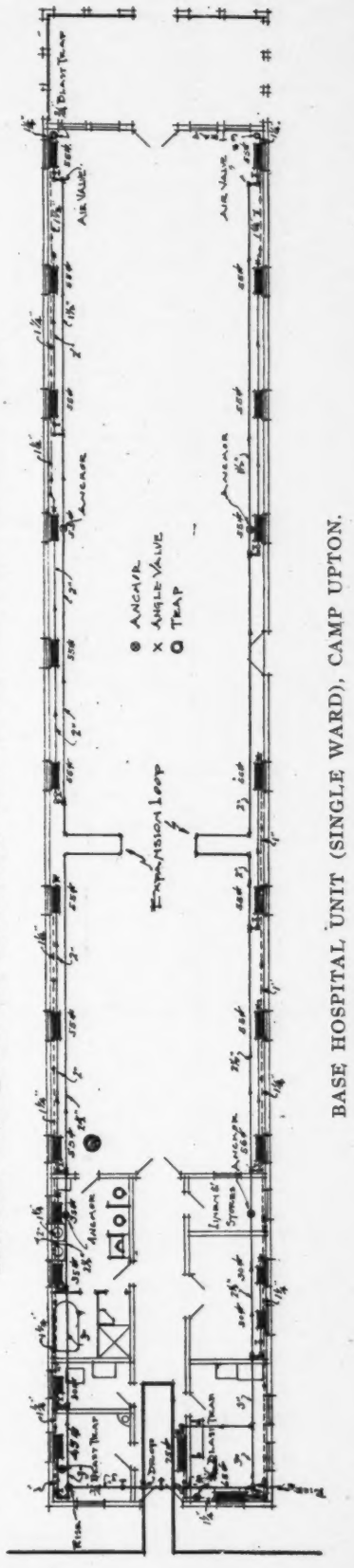
BASE HOSPITAL UNIT, CAMP UPTON, SHOWING METHOD OF PIPING CONNECTIONS TO RADIATORS.

hair felt, the whole being enclosed in water-proof roofing paper, bound on with twine. Here again the time factor was paramount, making it out of the question to lay the piping underground. Provision is made for expansion by the use of expansion loops and expansion joints, the loops being adopted wherever possible. These are shown in the single and double wards on the group plan of the base and cantonment hospital units.

There is a high-pressure system of steam distribution and a hot water circulating system which is carried through most of the hospital buildings and which runs parallel with the low-pressure heating mains. High-pressure steam is used for sterilizing purposes in the hospital group; the hot water supply is connected to the various toilet fixtures and is also used for other purposes incidental to hospital work. The total amount of radiation in the hospital group is approximately 90,000 sq. ft.



DIVISION HEADQUARTERS BUILDINGS, CAMP UPTON, SHOWING HEATING LAYOUT.



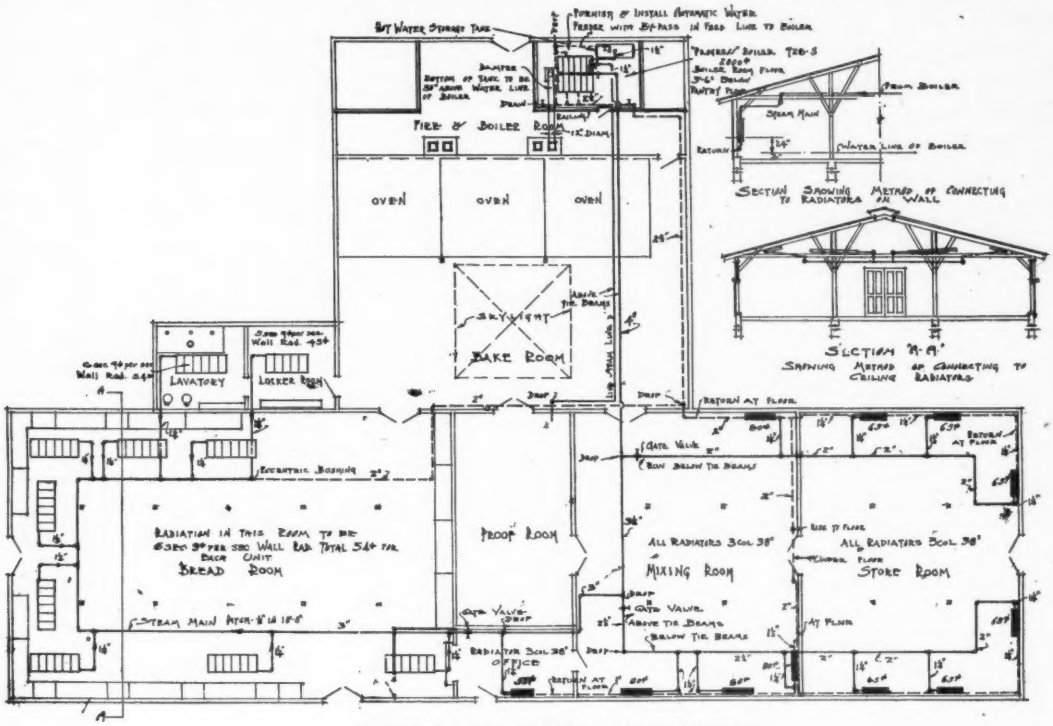
BASE HOSPITAL UNIT (SINGLE WARD), CAMP UPTON.

OFFICERS QUARTERS.

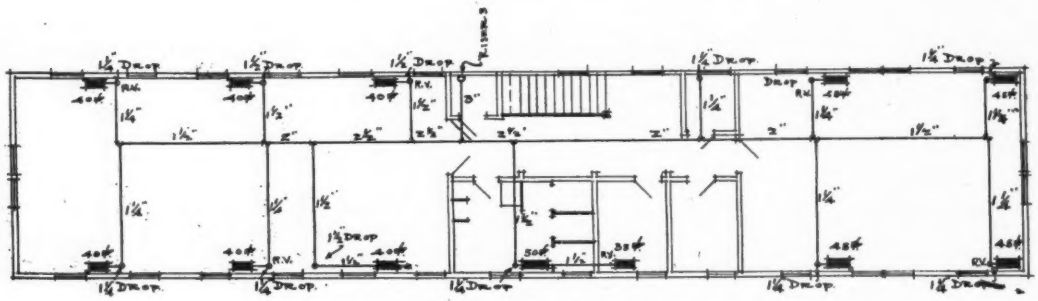
Approximately 108 buildings used as officers' quarters are scattered through the camp. These buildings range in size from 20 ft. × 70 ft. 6 in. to 20 ft. × 133 ft. Each building is heated by a separate steam heating system, with direct radiation. As a rule, the boiler is located in a separate building, midway of the length of the main building. The radiators are set up from the floor and a single-pipe system installed, the pipe running beneath the radiators, with a vertical branch to each radiator.

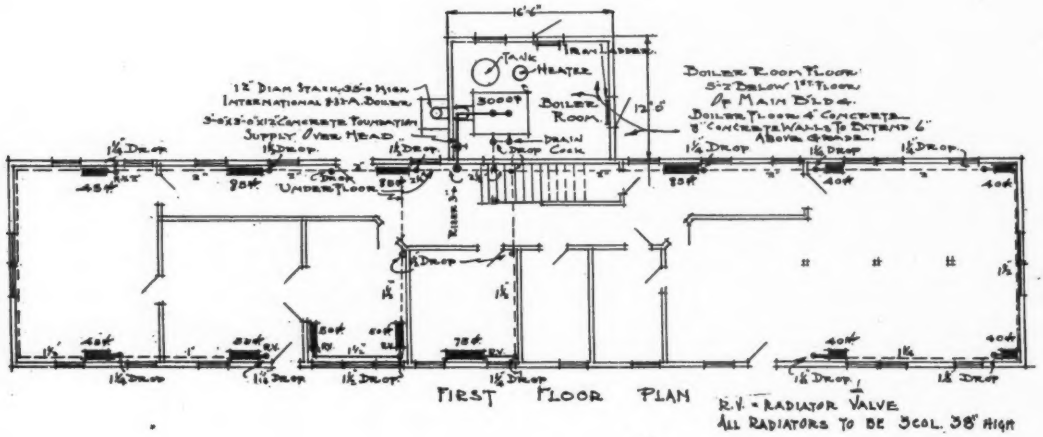
MEDICAL DEPARTMENT BUILDINGS.

There are fifteen medical department buildings, each two stories in height.

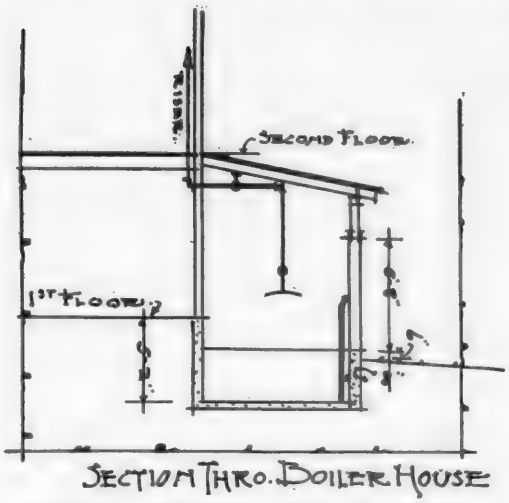


BAKERY BUILDING, CAMP UPTON.





MEDICAL DEPARTMENT BUILDING (ARTILLERY), CAMP UPTON.

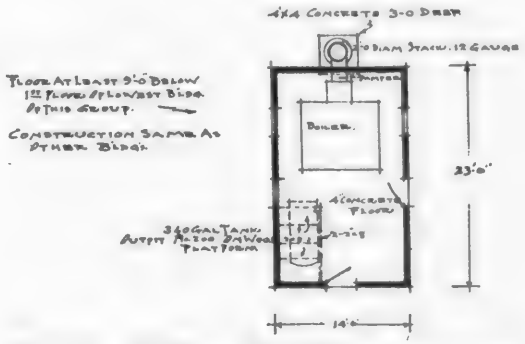


SECTION THROUGH BOILER HOUSE, MEDICAL DEPARTMENT BUILDING.

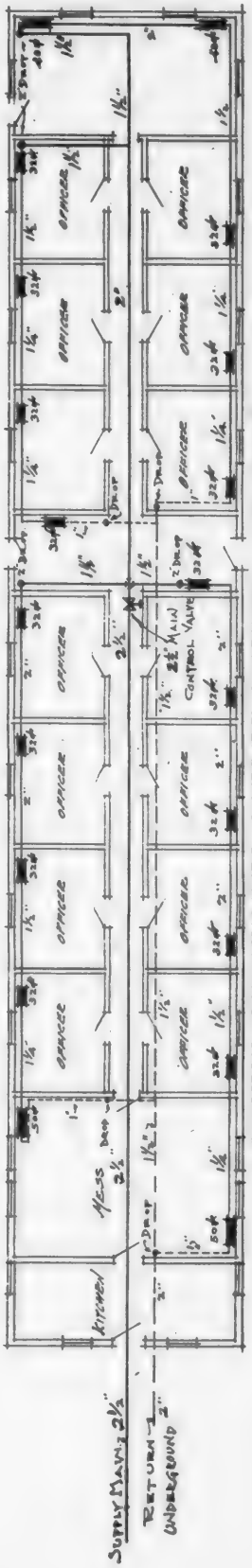
The general arrangement of the steam distribution is the same as in the officers' quarters, except that the steam distributing mains are carried to the ceiling of either the first or second floor, with a drop-feed system, the return lines being run above the floor. In these buildings the radiators on the second floor are placed directly on the floor, while those on the first floor are raised on pedestals, as previously described, with the return lines running underneath.

BARRACKS.

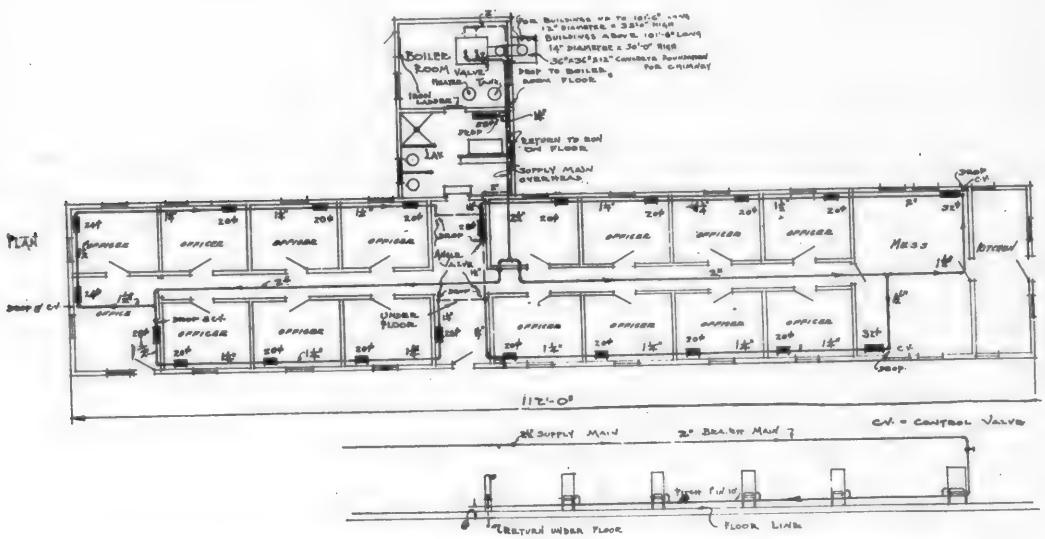
In general the barracks are two-story buildings, 140 × 43 ft., divided by a hall in the center on the first floor. This part of the barrack is heated by a stove and the rooms on either side of the hall are heated by room heaters which are placed



BOILER HOUSE, DIVISION HEADQUARTERS, CAMP UPTON.



DIVISION HEADQUARTERS, OFFICERS' QUARTERS, CAMP UPTON.



DIVISION HEADQUARTERS, OFFICERS' QUARTERS (MAIN BUILDING), CAMP UPTON.

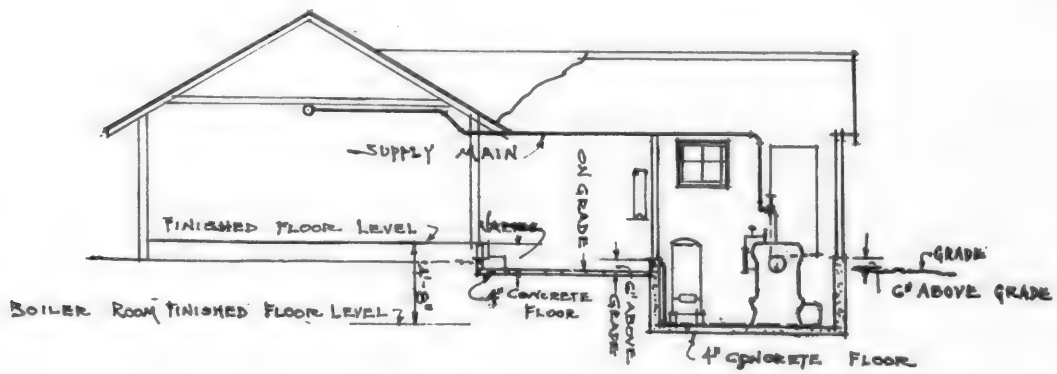
substantially in the center of the room. The second floor is heated by two room heaters placed substantially in the center of the space to be heated. There are approximately 250 of these buildings at Camp Upton, in addition to other types of barrack buildings.

With a problem so large as the building of sixteen cantonments, each capable of housing approximately 40,000 men, and with the building of approximately thirty-two other camps, all requiring heat, it will be understood that the difficulties of securing sufficient and suitable material were very great. The resources of the country had to be mobilized.

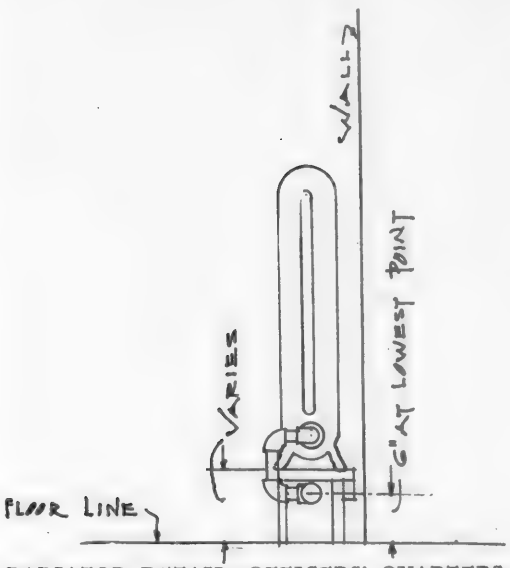
In passing it might be stated that several of the sixteen National Army cantonments have group steam heating plants, including many more steam-heated buildings than at Camp Upton.

HEATING REQUIREMENTS.

In connection with the heating requirements the hospital groups of the various cantonments were computed for the maintenance of 70° F. in zero weather. In the more northern locations an increased amount of radiation was provided, and in southerly locations, less radiation was installed. The officers' quarters and the barracks were com-



SECTION THROUGH OFFICERS' QUARTERS, (MAIN BUILDING.)



RADIATOR DETAIL, OFFICERS' QUARTERS.

puted for a temperature of 60° F. The capacity of the room heaters was figured on the basis of the approximate amount of coal burned per square foot of grate, with an assumed efficiency of the heater.

In spite of the tremendous exertions put forth to have the cantonments finished on time, there were some remarkably close connections made which will long remain the talk of the trade.

With the approval of the Secretary of War, the following statement concerning the heating facilities of the various cantonments is made by Brigadier-General Isaac W. Littell, in charge of cantonment construction:

Four camps are steam heated throughout, with the exception of a few small units using stoves, constituting less than 10%. These four cantonments are Camps Devens (Ayer, Mass.), Custer (Battle Creek, Mich.), Grant (Rockford, Ill.), and Funston (Fort Riley, Kan.).

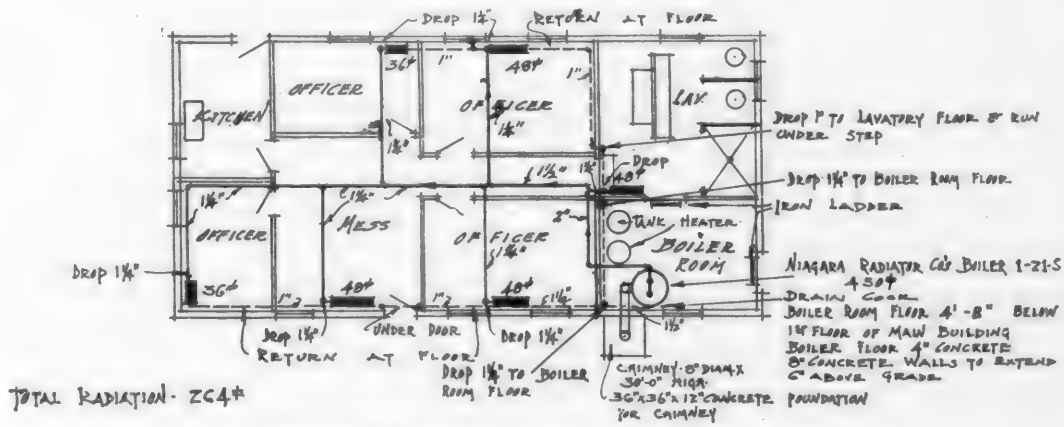
The remaining 12 have steam heat in hospitals and officers' quarters. The barracks are heated by large hot-air furnaces, as are the mess halls. There are four large heaters to each barrack.

Such delay as has occurred has been mainly in the installation of steam-heat facilities. Temporary stoves were put in use to offset the slight chill of October weather wherever permanent heating plants were not complete.

Work at Camp Devens was somewhat delayed by the failure of manufacturers to deliver as rapidly as promised the necessary fittings, valves and piping. With the arrival of materials, steam fitters were put to work, and, in most important parts of the work, in shifts for the 24 hours of the day.

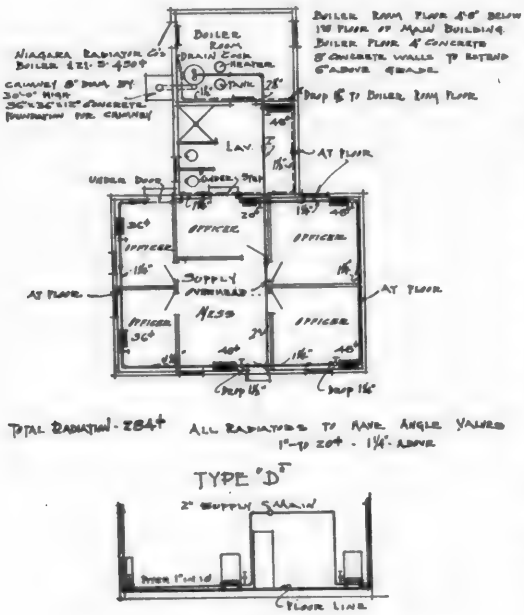
At Camp Custer, Battle Creek, 9 of the 14 steam plants are in service and approximately 300 stoves have been set up pending completion of the remainder of the steam-heat apparatus.

At Camp Grant, Rockford, 12 out of the 15 steam plants are in service and completion of the entire system was scheduled by October 23.



TYPICAL OFFICERS' QUARTERS, CAMP UPTON.

At Camp Funston, Fort Riley, there were 140 steam fitters and 140 helpers engaged in the work of installing the



OFFICERS' QUARTERS, TYPE D, CAMP UPTON.

steam plants. Three out of the 18 proposed are in service.

In the remaining 12 cantonments the room furnaces are practically all in place and the heating arrangements are well advanced.

The system of steam heating adopted for the first four cantonments named is the same as is used by many industrial plants where the units are widely scattered.

The overhead system of steam heating for these four cantonments is the best obtainable for cantonment purposes. The question of loss of heat is a matter of insulation entirely. Either an overhead or underground system will lose heat if the insulation is imperfect. The plans call for complete insulation of the pipes, and the heat will be as well preserved overhead as underground. Overhead piping is not only cheaper, but may be more quickly installed and more readily repaired.

Ventilating Conditions in Textile Mills

In spinning rooms of mills employees occupy from 500 to 1,000 sq. ft. of floor space, and so, for usual story heights, from 5,000 up to as much as 12,000 cu. ft. of space, per employee. The window openings will vary from as little as one-fifteenth to as high as one-sixth in unusual cases. The average will probably be about one-tenth. Weave-shed workers will occupy about the same amount of floor space in general as that given for spinning employees, whereas the cubic space will be even greater. Not all weave sheds are well supplied with windows, but the ventilators usually placed in the peak of the sawtooth skylights will act in the place of windows.

It must be evident that so far as the amount of space per employee and the available openings to outside air are concerned, textile mills seem to be well ventilated, and general experience would seem to bear out this conclusion. In some individual mills, poor conditions undoubtedly obtain, due to local influences which it is impossible to consider in this paper. Actual conditions must be studied over a long period of time in order to determine whether the ventilation of any particular mill is sufficient.

However, ventilation is a subject that cannot be considered absolutely alone, for proper ventilation is affected seriously by and in turn itself affects two other factors, temperature and humidity, both of which in their inter-relations have serious effects on health.

In most modern textile plants the relative humidity is kept at or near a constant point by artificial apparatus for manufacturing reasons, and it thus becomes necessary to maintain the temperature of the workrooms at that point in relation to the humidity which will result in the greatest comfort to the employees; in other words, to provide only so much external heat as is necessary to prevent the body radiating more heat than it produces. *W. Fred Dolke, Jr.*

CHICAGO COMMISSION ON VENTILATION

Organization of the Chicago Commission on Ventilation

The Chicago Commission on Ventilation was organized in February, 1910, so that it is now in its eighth year. In 1914 the commission published a lengthy report of its work up to that time which included tests made by the commission on the ventilation of passenger cars, picture theatres, an experimental schoolroom, an office and an experimental cabinet.

Much experimental work of great value and importance has been done since 1914. By a special arrangement with the Chicago Commission on Ventilation, the reports of this work, as well as all future tests and experiments, will appear exclusively in the columns of THE HEATING AND VENTILATING MAGAZINE, except that the commission will have reprints available, following publication.

It will be of interest to our readers to know that at the organization meeting of the commission, in 1910, it was agreed that:

1. In the construction of new buildings, ventilation is not receiving the consideration which its importance warrants.
2. Our present methods of ventilation are based on standards which are more or less traditional and without scientific foundation.
3. All the factors which influence the ventilation of a building are not understood.
4. The importance of ventilation makes it most desirable, if not entirely necessary, to conduct such experiments as will make the practice of ventilation a branch of applied science.

THE WORK OF THE COMMISSION.

Except for the work done with the experimental cabinet, all studies and tests conducted by the commission are made in rooms or buildings of full size, and substantially under normal conditions of use. Much criticism is sometimes offered against conclusions drawn from studies made with models or miniature structures usually housed within a room. If such criticism be just, then it is fortunate that the commission's work was necessarily done in enclosures of full size and built in accordance with various architectural designs.

One of the first things the commission undertook was to make a general study of the ventilation in restaurants, cafés, hotel dining rooms, bakeries, printing offices, office buildings, and other places in which health might be impaired because of the lack of good ventilation. Some of the present ordinances in the Chicago city code are based upon these studies.

PERSONNEL OF THE COMMISSION

Organizations having representation in the Chicago Commission on Ventilation, together with a list of members:

CHICAGO DEPARTMENT OF HEALTH.

John Dill Robertson. E. Vernon Hill, M.D.

CHICAGO BOARD OF EDUCATION.

John Wilkes Shepherd. John Howatt.

ILLINOIS CHAPTER, AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.

Samuel R. Lewis. James H. Davis. H. M. Hart.

ILLINOIS CHAPTER, AMERICAN INSTITUTE OF ARCHITECTS.

George Beaumont.

ILLINOIS SOCIETY OF ARCHITECTS.

Meyer J. Sturm.

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CHICAGO SECTION, AMERICAN CHEMICAL SOCIETY.

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MUNICIPAL TUBERCULOSIS SANITARIUM, OF CHICAGO.

C. P. Caldwell, M.D. F. Bowden De Forest, M.D.

HONORARY MEMBERS.

W. A. Evans, M.D. George B. Young, M.D.

CHICAGO COMMISSION ON VENTILATION

Ventilation Test of the Lewis Champlin School

Conditions Found in a Modern Chicago School Building Equipped with the Latest Type of Heating and Ventilating System.

Introduction.

The introduction into and removal from a building of a given amount of air do not constitute ventilation. The introduction into and removal from a room of enough air to change the entire contents of the room in a given time do not constitute ventilation.

It is necessary so to deliver and remove the air that it shall reach all of the occupants. It is necessary to deliver it at such speeds and temperatures that it shall not be uncomfortable to the occupants. It is highly desirable to condition the air so that it is properly moist, and also so that a minimum amount of dust is carried with it.

When all of the windows in a room are opened and there is a breeze outside, the entire contents of the room are swept out very rapidly, amounting to a horizontal displacement of all of the air in the room in, say, sixty seconds. Such ventilation as this is not practicable in cold weather except at intervals, for very short periods, to flush the room. Much dust may enter the room with such ventilation. The limitations as to cost of heating apparatus and fuel have restricted ventilation to a very much smaller range than that above mentioned.

WINDOW VENTILATION.

Where windows are used for admitting cold air, the amount admitted depends on the facilities provided to permit its escape, and on the capacity in the heating system available for warming it in addition to that needed merely to overcome the loss of heat through the cool walls and glass. Thus, reasonable ventilation undoubtedly can be obtained, under skillful manipulation of the windows for rooms occupied by one or two persons per window, especially when chimneys are provided for effecting a constant air removal. When more air is admitted by windows than can be heated to nearly the room temperature almost instantly, there will be cold drafts and discomfort, unless the occupants are especially dressed to offset this. By "reasonable ventilation" we assume the standard commonly used, 30 cu. ft. of fresh air per minute per person, which again means by CO_2 index about six parts of carbon dioxide per 10,000 parts of air. Thirty cubic feet of air per minute per person will do nicely when but 30 cu. ft. per minute have to be brought in through one window and there is a large cubical content of warm air to mix with or dilute it, but the problem becomes more difficult in an elementary school room having fifty occupants. In school rooms there are seldom more than six windows on the windward side and at the best each window would have to supply eight pupils. With such ventilation, those near the windows get the best of the fresh air; also the most of the drafts and dust. When the weather is inclement, rain or snow also enter, with unfortunate results.

CONDITIONS FOR ADVOCATING WINDOW VENTILATION.

For the foregoing and many other reasons, we can not advocate for standard practice in elementary schools with pupils in normal health any system of

window ventilation of which we have ever heard. We do recommend the use of windows whenever the weather permits their operation without discomfort, and we do recommend the frequent flushing of the rooms by opening all of the windows.

LIMITATIONS OF GRAVITY VENTILATION.

There are so-called gravity systems of ventilation for schools which attempt to overcome the objectionable features of window ventilation by providing means for heating the entering air, and such systems usually employ heated chimneys to do the work of air carrying. These systems when at their highest efficiency, are quite similar as to interior conditions to the mechanical systems of school ventilation. Unfortunately, the highest efficiency of such systems is dependent on the human element and the difference in temperature between indoors and outdoors and is greatly affected by wind. Gravity ventilation has no advantages over mechanical ventilation, except that it is usually less expensive in first cost. It gives no results in any phase which surpass mechanical ventilation, and is subject to all of the objections which follow the latter. It is usually more expensive to operate from the fuel standpoint.

CONDITIONS WHICH SHOULD GOVERN VENTILATION.

It is, of course, desirable to arrive at some specific amount of air which should be introduced in each minute for each occupant. So far as we know, the carbon dioxide content of the air is not the condition which should govern ventilation. We use the CO_2 content merely as an index of the air supply and distribution, although so far as is known no quantity of CO_2 practicably possible in respired air is of any particular harm. In the light of present knowledge, ventilation must be governed by temperature, moisture, odor, the dust carried in the air, and other factors, as well as the chemical condition of the air. Ventilation is efficient if the air in its passage evenly renews the aerial envelope about the bodies of the people, and if the removal of the contaminated air is prompt and direct.

Practice in the art of designing ventilation systems has developed, for the Chicago elementary schools, apparatus which will furnish a minimum of 1,500 cu. ft. of air per minute for each fifty pupil class-room. This amount of air is far short of the 10,000 cu. ft. per minute possible with all windows open. To deliver even 1,500 cu. ft. per minute, however, is a real problem. The air should be as free from dust as possible; it must cause no noise as it passes through the ducts and registers. It must even at this quantity (say, an air change once in seven minutes) be warmed to within about ten degrees of the room temperature, or much discomfort from drafts is occasioned. It must be moistened so as to reduce the temperature necessary for comfort and to minimize evaporation from the bodies of the pupils.

VENTILATION IS BY DILUTION, RATHER THAN BY DISPLACEMENT.

The delivery of enough air through the supply register to change the contents of the room once in seven minutes does not mean, unfortunately, that the contents will all be changed. The entering air may be sufficient in quantity and there may be installed positive means of removing from the room a like amount, but even so, the distribution of the fresh air usually is very uneven. Air is so elastic, and changes its weight per unit volume so quickly in response to changes in temperature that ordinary ventilation necessarily has to be largely by dilution, rather than by displacement.

VENTILATION BY DILUTION DEFINED.

Ventilation by dilution may be de-

scribed as the ventilation in any room which has cold walls, any local source of heat, such as radiators, stoves or animals, and which has a comparatively small constant air supply and exhaust, whether above or below atmospheric pressure. Such ventilation results from every local contact of air with objects of different temperatures, which cause an upward or a downward current of considerable proportions, regardless of whether the air is fresh or contaminated.

We have built small toy windmills which will be caused to revolve by the rising current of air actuated by the heat of the human hand. The entering fresh air, if warmer than the air in the room, rises to the ceiling; if cooler, it falls to the floor. If the outlet is at the floor and convenient to a downward fresh and cool current, the fresh air will short circuit out, leaving the contaminated air in blissful occupation of the breathing zone. Under such conditions, of course, each warm thing in the room would be promoting the dilution by causing the fresh air to rise to replace the air warmed and so pumped up by contact, and each cool thing, such as the windows, would be causing the displacement from the floor into the breathing zone of fresh air, by the falling currents of cooled contaminated air.

VENTILATION BY DISPLACEMENT.

Ventilation by displacement may be described as the ventilation in any room when the windows are opened on each side so that the wind may cause a complete horizontal displacement. Where it is possible to introduce fresh warmed air through an opening under each seat, as in many theatres and churches, the ventilation is by displacement, if it rises directly to the ceiling and so passes out. Practically, ventilation by displacement is only possible under such conditions or where a very small difference in temperature may be obtained between the room and the entering air, without local or cold surfaces to cause vertical mixing current. Some interior rooms of buildings having no heaters and no windows or cold walls are satisfactorily ventilated by displacement with air movement from side to side at the breathing zone. Ventilation by displacement is not practical in the ordinary class-room as now constructed.

The Chicago Commission on Ventilation, however, has had an experimental class-room, using this principle, in use under observation, for several years. This class-room has inlets for fresh air under every desk, and is provided with special air chambers under the floor and over the ceiling.

STANDARD EQUIPMENT FOR CHICAGO SCHOOLS.

The Chicago schools are practically all equipped with mechanical ventilation, and the standard procedure is to arrange the ventilating systems so as to deliver a minimum of 30 cu. ft. per pupil per minute, under a slight pressure, occasioned entirely by the resistance of the duct systems. The pressure at the supply fans is depended upon to deliver the air to the rooms and gradually to force the contaminated air out of the rooms through flues to the roof ventilators. This pressure is seldom sufficient to overcome the inward leakage due to the wind and usually such is this leakage that rooms to windward show more air leaving the rooms through the exhaust flues than is entering through the supply flues, while the rooms on the lee-side show very much less air leaving by the exhaust openings than is delivered by the fan. This leakage in and out through walls and windows is a well-known phenomenon, and is not particularly objectionable, as it assists in the ventilation, when ventilation by dilution must be used.

Experiments have been made which show that a ten mile per hour breeze is approximately sufficient to balance the static pressure ordinarily maintained in the Chicago schools.

A heated room and a heated building are under a considerable air pressure out at their tops, due to the tendency of the lighter heated air to rise, and under a corresponding cool air pressure in at their bottoms. If a window in a heated room be opened there will nearly always be a draft outward at the top, and inward at the bottom, no matter what sort of heating system is used.

Test of the Lewis Champlin School

Princeton and Englewood Avenues,
Chicago, Ill.

The selection of the Lewis Champlin School for testing was brought about by the following considerations:

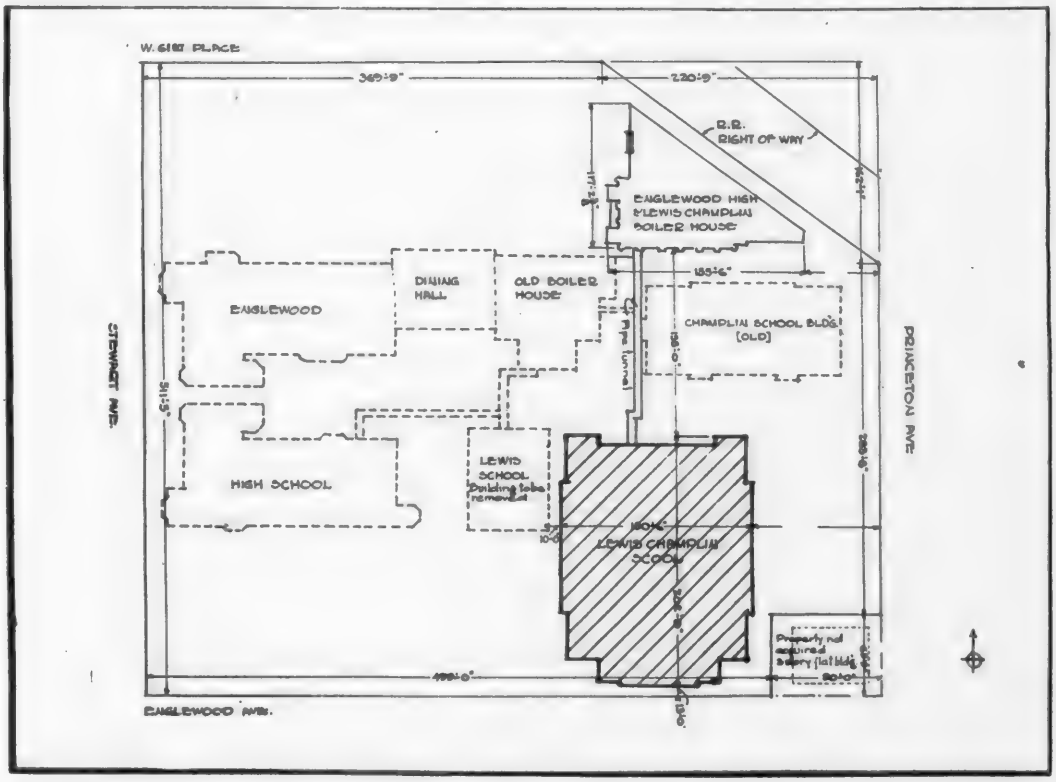
It is one of the latest Chicago schools to be put into service, having been completed in the fall of 1916, and has presumably as modern and efficient an equipment for heating and ventilating as any in the city.

It is large enough to give representative rooms, as it is built to accommodate about 1,100 pupils.

It has arrangements whereby the air may be recirculated within the building, by using the corridors as return ducts.

PURPOSE OF TEST.

The immediate purpose of the test was to obtain information as to the efficiency of the ventilating system, particularly as to air distribution within the rooms, and as to the condition of the air, as deter-

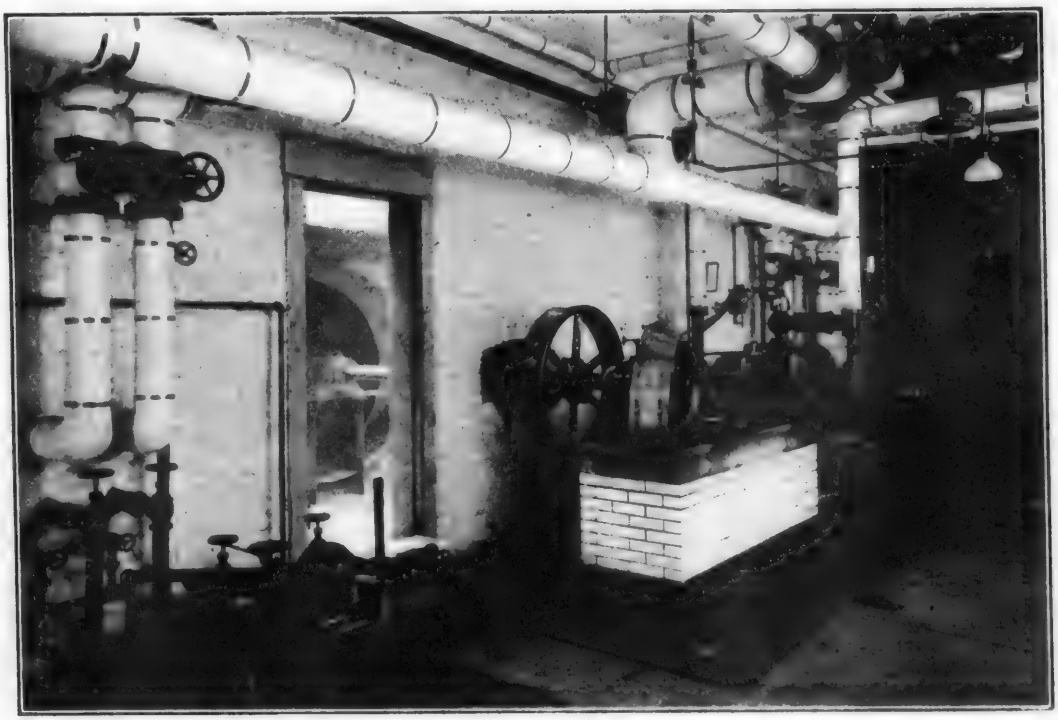


PLAT PLAN, LEWIS CHAMPLIN SCHOOL, CHICAGO AND NEIGHBORING BUILDINGS.

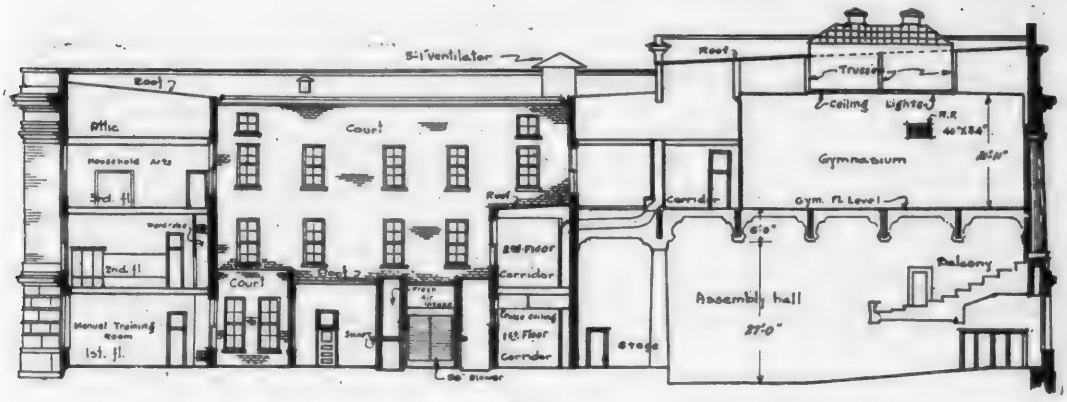
LEWIS CHAMPLIN SCHOOL.

mined by simple chemical, bacteriological and physical observations. The ultimate purpose is to determine whether or not any improvements in the design for operation of the plant can be suggested, in accordance with the general desire of the Chicago Commission on Ventilation to determine means whereby the air conditions inside buildings may approximate the best air conditions outside buildings.

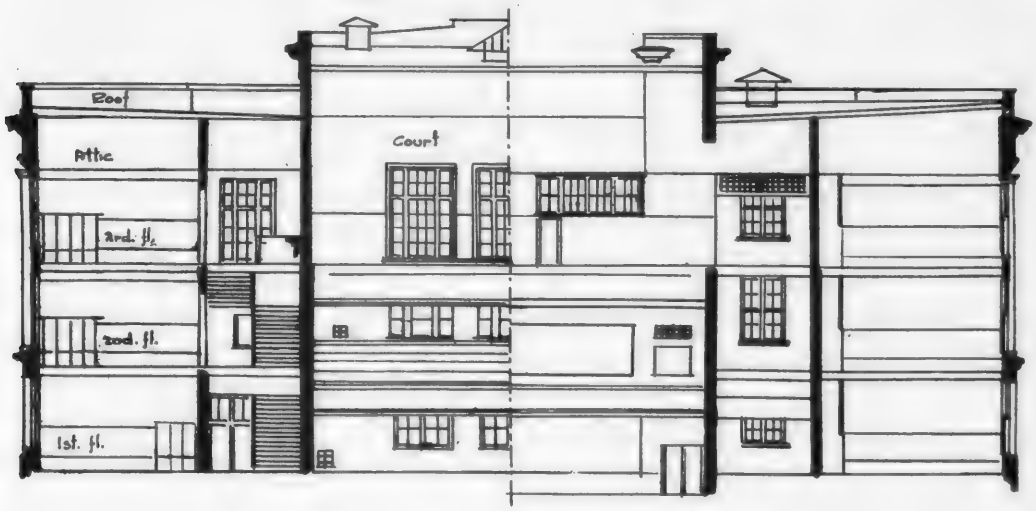
The building is about 200 ft. × 145 ft., three stories high, of fireproof construction, with a shallow attic space and flat roof.



ENGINE ROOM, LEWIS CHAMPLIN SCHOOL.



SECTION C-C.



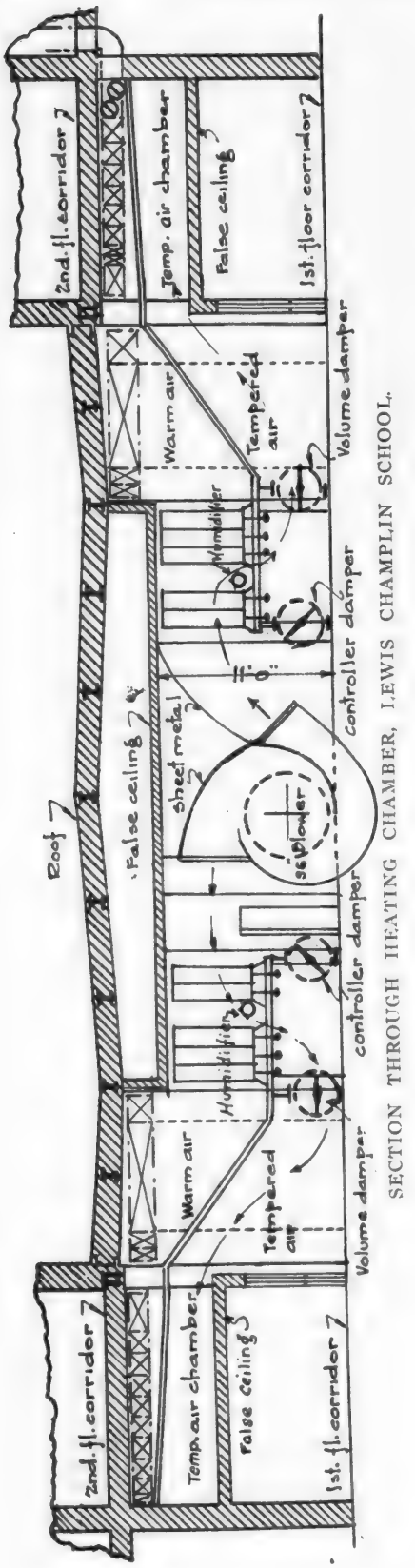
SECTION A-A

SECTION B-B.

SECTION D-D

SECTION E-E

SECTIONAL ELEVATIONS, LEWIS CHAMPLIN SCHOOL.



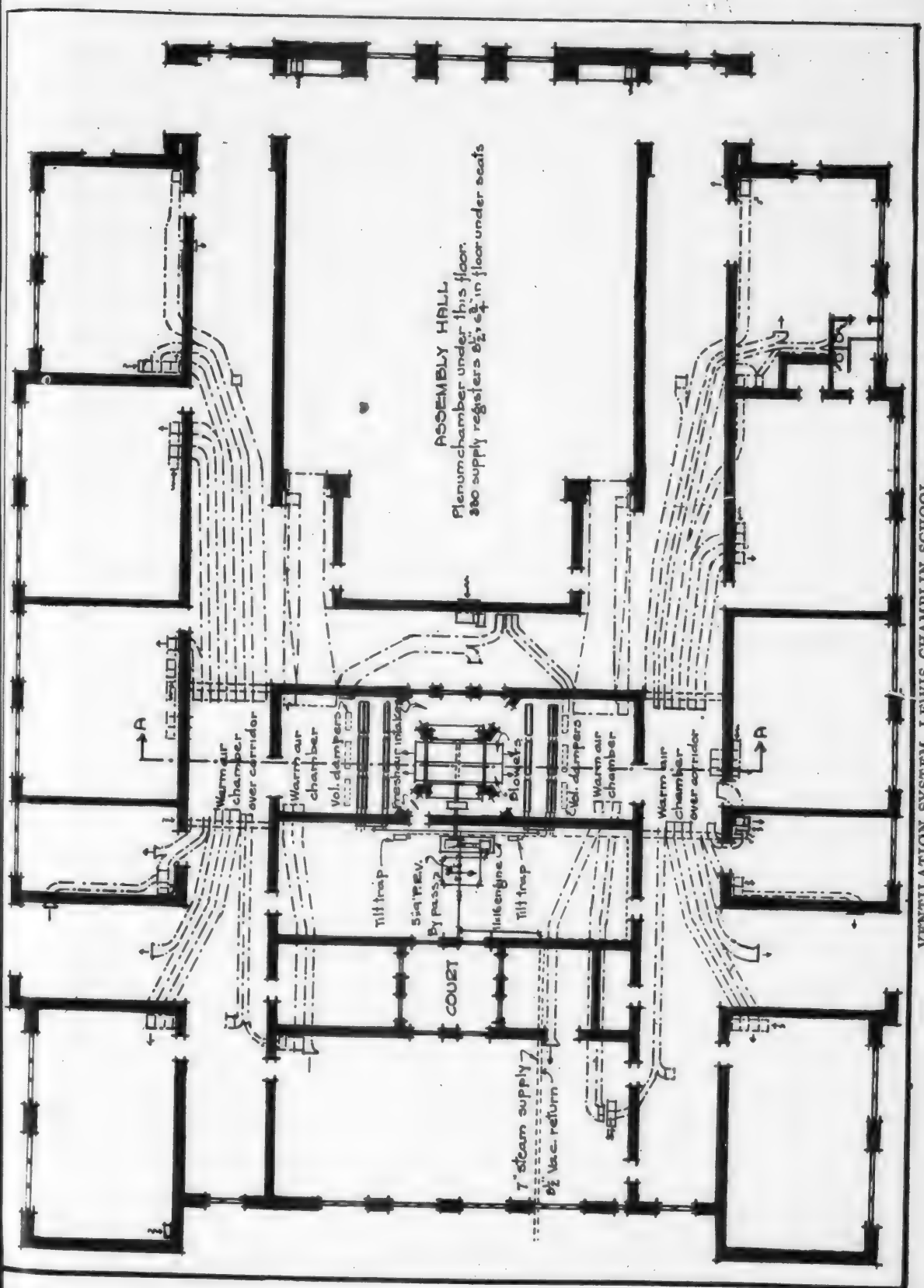
SECTION THROUGH HEATING CHAMBER, LEWIS CHAMPLIN SCHOOL.

COURT OF LEWIS CHAMPLIN SCHOOL, SHOWING INTAKE AND VENTS ON ROOF.

DESCRIPTION OF SYSTEM.

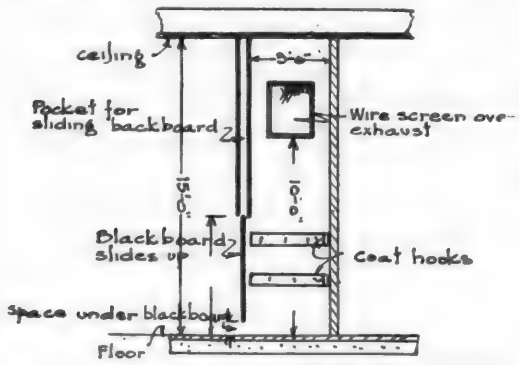
Steam at about 90 lbs. pressure is supplied from a detached boiler-house through a tunnel. The heating is accomplished with exhaust steam, supplemented with live steam, introduced through an automatic pressure regulator, and is circulated at not exceeding 3 lbs. pressure. The returns are under the suction of a vacuum pump in the boiler-house.

The fresh air supply is drawn from an interior court, paramount to taking it from the third floor level. It passes through the engine-driven fan, then through heaters arranged so as to provide two temperatures of air, one at about 120° F., the other at about 60° F. The hot air (120°) is delivered into the upper part of a large plenum chamber, and the tempered air (60°) is delivered into the lower part of the chamber. There are two such chambers in the Lewis Champlin School. From these chambers comparatively small horizontal metal ducts extend along the ceiling to the first floor rooms, and to the bases of the vertical flues leading to



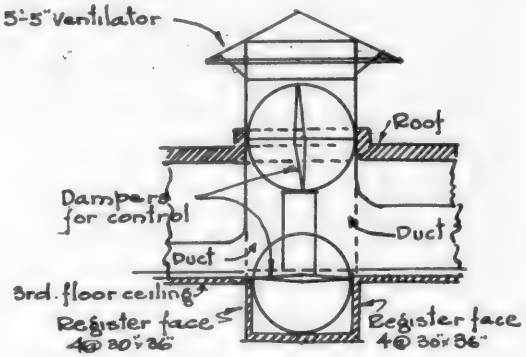
VENTILATION SYSTEM, LEWIS CHAMPLIN SCHOOL.

the second and third floor rooms. In each of these ducts there is placed a double mixing damper, actuated by a thermostat in each room, so arranged that by taking either hot or tempered air, or part of each, the temperature in the duct may be at any required point be-



SECTION THROUGH WARDROBES, SHOWING METHOD OF EXHAUST.

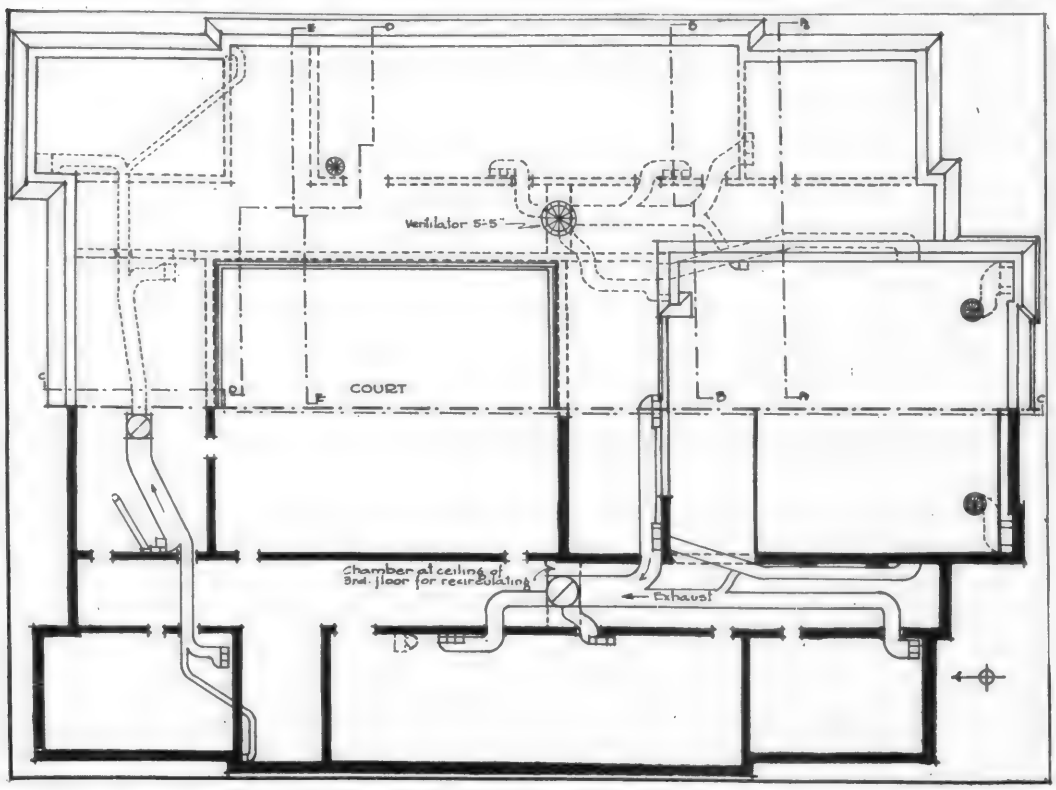
tween 60° and 120° (approximate limits). This variation in temperature is intended to be accomplished without any variation in air volume.



SECTION OF TYPICAL VENTILATOR AND RETURN AIR CONNECTIONS.
(One in East and One in West Corridor, Third Floor.)

METHOD OF MOISTENING AIR.

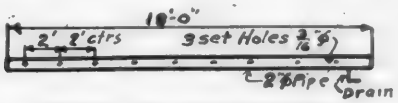
Steam jets, controlled by automatic humidity controllers, are provided in each of the two main air chambers and arranged to bring the steam in contact with the air at an air temperature of about 60°. It is ordinarily practicable with this type of humidity introduction to obtain 50% relative humidity at 70° F. dry bulb temperature, whether hot



VENT DUCTS AND CONNECTIONS, ROOF AND ATTIC, LEWIS CHAMPLIN SCHOOL.

air or tempered air is being introduced.

By manipulation of the dampers controlling the admission of air to the tempered air chambers, it is possible to close



STEAM JET HUMIDIFIER.

entirely all air supply to them when heating the building prior to occupancy, obtaining a cumulative heating effect since, as room after room reaches a temperature of 68°, the hot air dampers are closed by the thermostats, and the hot air supply which has heated them automatically is diverted to hurry up the heating of the remaining cold rooms, until, finally, the entire heating power of all of the indirect radiation in each plenum chamber goes to the slowest room to heat. The rooms which have reached 68° are, of course, not ventilated during this period, but are stagnant, since all tempered air is closed off. There is no objection to this procedure if used prior to the arrival of the pupils; moreover, it is an effective step toward economy.

LOCATION OF AIR INLETS AND OUTLETS.

The air enters the standard classrooms about 7 ft. above the floor, and leaves them under the bottoms of the sliding wardrobe partitions, which also carry the blackboards. Passing upward over the clothing in the wardrobes, the air passes in flues to the attic. In most cases, the wardrobes are on the same sides of the rooms as the inlet openings, but in some cases they are directly opposite. In the auditorium, the air enters through a large number of evenly distributed floor registers beneath the seats, and leaves mostly at the floor level, through flues in the outside walls. In some other rooms, of special type, the air leaves the rooms through registers at the floor level, on the same side of the rooms as the supply openings. The toilet rooms are ventilated by separate flues and are so arranged that the toilet room air can not be recirculated.

The general building vent flues are connected in the attic with metal ducts to two outlet chambers. These are open at the top to roof ventilators, and at the bottom to large grilles on the ceiling of the third floor. Pneumatically-operated dampers permit the air to escape out of doors, or to pass down into the corridor, when it is desired to recirculate the air.

SIZES OF APPARATUS:

Boiler plant—1,200 H.P., in central plant, which supplies several other buildings in the Englewood High School group.

Supply fan—Multiblade type, 70-in. wheel, double wide, double delivery, double inlet, capacity about 90,000 cu. ft. per minute at 160 R.P.M.

Engine—Direct-connected, 11 in. × 16 in., throttling, about 160 R.P.M.

Tempering Heaters—2,860 sq. ft. surface, 1 in. pipe in cast-iron bases, center-bottom single, pipe connection.

Reheaters—4,292 sq. ft. surface, 1 in. pipe in bases of the same type.

Tests were made by employees of the Chicago Commission on Ventilation, using the standard methods and appliances of the commission, described in general in the appendix to the 1914 report.

In addition to those devices, the dust counter of Dr. E. V. Hill, 1917 type, was used instead of the Aitken dust counter. Unless otherwise stated, air volumes were taken as described, by calibrated anemometer. The temperature readings, unless stated otherwise, were taken at 4 ft. above the floor.

Preliminary tests, to establish familiarity with the practice, and for development of the program, were made at various times in January and February, 1917. The dates of the various tests appear on the charts.

The various conditions observed will be presented in next month's issue of THE HEATING AND VENTILATING MAGAZINE *under the following heads, as observed in the various rooms:* (1) *Air volume (distribution, motion);* (2) *Temperature;* (3) *Moisture;* (4) *Dust; and* (5) *Bacteria. Test sheets will also be shown covering observations of rooms* 104, *the kindergarten and Rooms* 201, 209, 301, 304 and 305.

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BY THIS time the heating installations in the great army encampments are practically complete, as far as the plans laid out by the Constructing Quartermaster's office are concerned, but our readers will not fail to notice that where stove heaters have been installed the government officials, as well as heating men generally, have gone on record as stating that this type of heater was used only on account of the exigencies of the situation and that "as a general proposition steam heating would have been favored above furnace heat, but the element of time was the deciding factor." Again, in the recent discussion in these columns of the substitution of "squad houses" for the regulation army barracks, it is stated that "the best system would be steam heat from a central plant and cast-iron wall radiators in the barracks."

The barrack buildings constitute the greater part of each cantonment; at Camp Upton, for instance there are 359 barrack buildings.

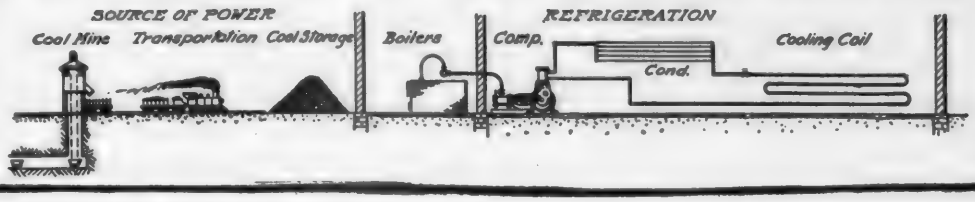
It is becoming more evident every day that these cantonments are not to be temporary propositions but are to serve as permanent training quarters, not only during the present war, but afterwards, when compulsory military service becomes the law of the land. It is, therefore, of great importance that the makeshift of stove heat for the barracks should be replaced by adequate heating systems as soon as possible and it is none too soon for heating engineers to take up this matter and be prepared, when the first lull comes, to do their part in equipping the camps for permanent service.

WE TAKE pleasure in announcing this month that through an arrangement with the Chicago Commission on Ventilation, THE HEATING AND VENTILATING MAGAZINE will hereafter represent the commission to the extent of publishing all reports of its tests and experiments. These reports will appear exclusively in this magazine, except that separate copies will be published by the commission for special distribution. Although the commission has published only one report, in 1914, it has not been idle by any means. The investigations and tests it has carried on not only cover a wide range, but have been made, as far as possible, on strictly practical lines in rooms or buildings of full size.

As nothing, since the 1914 report, has appeared, dealing with the commission's work, our readers may look forward with unusual anticipation to the forthcoming issues.

Each issue will be devoted to one report or more, the first being that of the ventilation tests made early this year in the Lewis-Champlin School, Chicago.

AIR COOLING AND REFRIGERATION



Air Cooling in A Chewing Gum Plant

One of the most interesting features of air cooling is its application to buildings, not for the sake of comfort, but for the purpose of making certain manufacturing processes a success. There are many manufacturers today who are experiencing troubles whose remedy lies unknowingly only in proper air conditioning, not alone as far as temperature is concerned but also in regard to the relative humidity which is best suited to the particular operation concerned. Gum manufacturers knew that on certain days the gum got too soft, and on other days it got too hard and brittle but they did not know the remedy, and it has been due solely to the initiative of certain manufacturers of air conditioning equipment that the remedy is now being applied, resulting in more perfect work and higher efficiency throughout.

Such an installation was recently installed by the Carrier Engineering Corporation, New York, in the plant of the American Chicle

FIG. 1—ARRANGEMENT OF DUCT SYSTEMS IN ROLLING, SCORING, SEASONING AND TRIMMING DEPARTMENTS, AMERICAN CHICLE COMPANY.

Company, Long Island City, and a brief description of the process of gum manufacture is essential to an appreciation of the value of the results accomplished.

COMPOSITION OF CHEWING GUM

In the first place, chewing gum is the result of various ingredients mixed together after being properly cooked, in which chicle is the important factor. Chicle is the product which is refined from the sap taken from the Sapoto tree which is a native of tropical climate, especially Yucatan and the southern part of Mexico, as well as the northern part of South America.

The crude chicle brought to this country in pieces weighing from 100 to 200 lbs. per piece contains anywhere from 10% to as high as 35% of moisture. In the process of converting the crude chicle into chewing gum, it is first taken to breaking-up benches; here it is handled by the operatives who chop the large mass into smaller pieces, sort out the different grades and colors and at the same time clean out the refuse, such as bark, twigs, leaves, etc. After properly cleaning the chicle, it is usually ground up into small granules about the size of a wheat kernel in a mill and then dried.

The drying of chicle has always been considered a rather difficult proposition to perform properly, requiring from 40 to 45 days by the use of the older method employed which was primarily to place the chicle on trays and in a room heated with direct steam coils. This time, however, has been greatly reduced and the proper drying procured in from 17 to 24 hours with the use of the Carrier differential vapor tension regulation. In the drying of chicle it is necessary to retain a certain definite percentage of moisture within the material to facilitate the next process of filtering same through filter presses after the mass has been cooked.

Air conditioning is not essential in the various processes the chicle undergoes after it leaves the drying room until it comes into the roll and scoring department. The processes in which air conditioning is not required comprise primarily the cooking, blending, etc. From the cooking department the chicle is brought into the roll and scoring department, containing the different flavors and all other ingredients. Here it is rolled into flat slabs of proper thickness, then scored by passing through the final rolls which impress the deep score of the proper size and shape into the gum.

HIGH TEMPERATURE IN THE SCORING ROOM

The roll and scoring department, due to the large amount of heat generated, is apt to experience high temperatures which aided by the evaporation of moisture from the gum is not always a comfortable room in which to work. It is not unusual to find the humidity and temperature so high as to cause sugar to liquefy and become a sticky, sirupy agglomerate. De-humidifying is very important, not only from the above mentioned standpoint, but to control and maintain the proper percentage of moisture in the gum while passing through the various rolls.

From the roll and scoring department the slabs or sheets of scored gum are passed on to the seasoning or so-called drying rooms, where the material is put on trays and allowed to season for a day or two.

It is very important that this department be conditioned to control the air, humidity and temperature since the percentage of moisture evaporated or allowed to remain in the gum is dependent on the conditions of the air.

If this gum, in the seasoning process, dries out too much it will be hard and very brittle, but if not enough moisture is removed, trouble is experienced in the next department where (becoming very plastic) it will cause a sticking of the gum to the wrapper, sweating and various other disadvantages.

From the seasoning room the gum, loaded on trucks, is passed along to the breaking-up or trimming-room. The gum upon entering the trimming-room must contain sufficient moisture so that it will not be too brittle and cause fracturing, yet must be sufficiently dry to break evenly and easily into shape as scored.

From the trimming-room the perfect slab gum is taken into the wrapping-room, which should also be properly conditioned to maintain a fixed and definite temperature and humidity. Thus the gum is wrapped and sealed to assure uniformity in quality of product.

The above relates to what is known as slab gum, while the process of chiclets, ball gum, or what is commonly known as tablet gum, is very similar to that of the slab shape, with the following exceptions:

From the trimming-room the separated mass of chiclets is taken to the coating-room where the same are put in revolving coating pans; the process here is to tumble them continuously while hot sugar syrup is applied to same at intervals until the tablets or balls have become encrusted with a sufficient and requisite sugar coating of proper thickness. The coating-room is usually an exceedingly warm room, due to the constant supply of hot air which is blown into the tumbling mass of gum for the purpose of rapid drying. If this air is properly applied and exhausted much of the heat will not be liberated into the workrooms, thus prevening oppressive conditions now so usual in gum manufacturing.

FIG. 2—DE-HUMIDIFIERS, VENTO HEATERS, FAN, ETC., PLANT OF AMERICAN CHICLE COMPANY.

From the coating pans, in some of the plants, the coated gum is taken to an enclosed room, known as the polishing-room, where coating-pans of like design are employed merely to tumble the gum for the purpose of polishing the surface of same. Instead of hot air, cold air is applied which, in addition to the room air, should be maintained at a fixed and predetermined temperature and low humidity to prevent the losing of the polished surface after it is attained, and which is highly desirable.

CAPACITY OF PLANT AS INSTALLED

The apparatus for the plant under discussion is designed to maintain 70° F. temperature in the rooms so requiring throughout the year with a constant relative humidity carried at all times. The exact percentage of this humidity, however, is kept strictly confidential in order to protect the owner's interests. In order to do this a de-humidifier of special design is installed with a capacity of 25,000 cu. ft. per minute which serves the rolling, scoring, seasoning and trimming departments, a room approximately 178 ft. x 87 x 13 ft equipped with double-sash on all windows.

FIG. 3—REFRIGERATION APPARATUS, PLANT OF AMERICAN CHICLE COMPANY.

The complete apparatus consists of the de-humidifier (just mentioned) Vento heaters (for winter use) a fan (to circulate the air) a circulation pump (for the de-humidifier water) and two ammonia compressors, with a condenser and cooling coils for the purpose of cooling down the re-circulated spray water used in the de-humidifer. Two complete duct systems run on the ceiling are installed as may be seen by reference to the view shown in Fig. 1. Here the nearer duct with the horizontal outlets is the supply duct and the farther duct with the vertical inlets is the exhaust duct.

The supply duct system is designed to distribute the air uniformly throughout the room without drafts. The supply outlets are all made horizontal in direction and each is controlled with a volume regulating damper; the outlet velocities are figured so as not to exceed 500 ft. per minute and the quantity of air is made sufficient so that the entering temperature need never be less than 50° F.

ARRANGEMENT OF AIR DUCTS

Parelleling the supply duct is the exhaust duct with all inlets looking downward and properly controlled by volume dampers. This duct picks up the air at the various points where the inlets are located and carries it back to the cooling apparatus, to be re-treated. Of course, one recirculation opening could be provided at the apparatus, but this would result in drawing all the air from the room towards this point which is objectionable owing to the fine sugar dust and sugar particles with which the air becomes filled, due to the processes of manufacture.

For this reason the air is picked up at various points and carried back in a separate duct to the inlet of the apparatus. The economy of the system is very apparent when it is considered that approximately all the air is recirculated constantly, re-washed and cooled, yet *with* ventilation provided in correct quantities by the operation of fresh and return air dampers automatically.

Fig. 2 is a view of the de-humidifier, the Vento heaters (standing on the heavy concrete foundation and encased in galvanized iron) the fan, driving motor and circulation pump. The fan is a Carrier Niagara Conoidal No. 8, driven by a 10 H.P., A. C. motor, and the circulation pump is a Buffalo double-suction centrifugal spray pump with a horizontal split shell and operated by a direct connected 7½ H.P., A. C. motor with a flexible coupling. The pump circulates about 200 gal. of water per minute to carry on the necessary cooling on days of maximum temperature.

The cooling of the spray water is accomplished by a refrigeration plant consisting of two 30-ton York ammonia compressors, each belt driven by a separate 35 H.P., A. C. motor set on the floor above, as shown in Fig. 3.

To cool the ammonia compressor jackets and to condense the ammonia in the ammonia condenser about 75 gal. per minute of cooling water is used. Two ammonia units were decided upon in order to render the liability of break-down less and to make the operation efficient when operated under only a portion of the maximum load which is the usual condition encountered in a plant of this kind, due to varying outside temperatures and humidity.

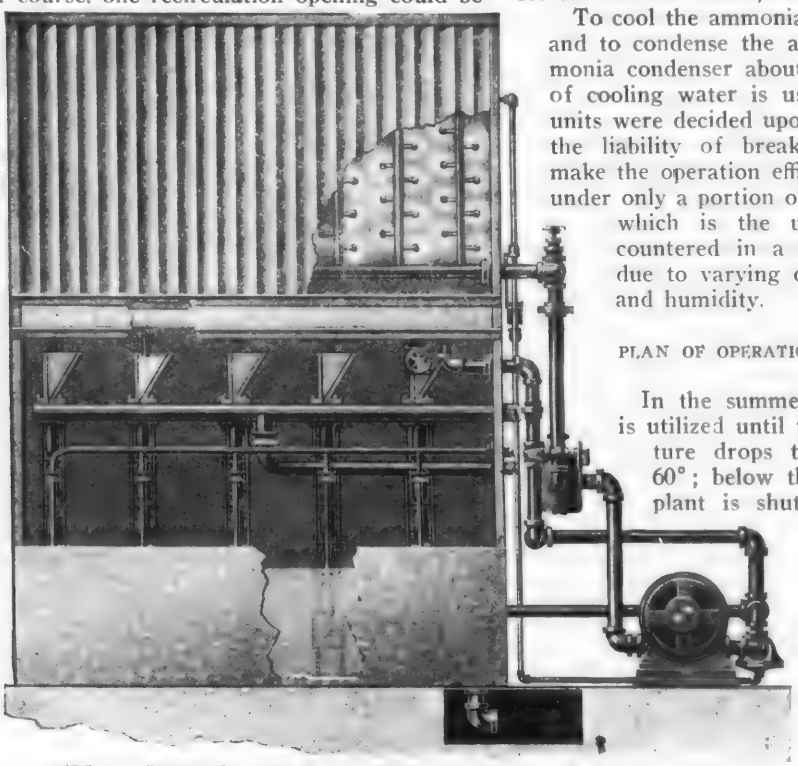


FIG. 4—SPRAYS AND WARM WATER TANK IN DEHUMIDIFIER.

PLAN OF OPERATION IN SUMMER TIME

In the summer time refrigeration is utilized until the outside temperature drops to between 50° and 60°; below this the refrigeration plant is shut down and, as the outside temperature continues to fall, warmer spray water and finally the Vento heaters are cut in to maintain constant room conditions. During the summer the *temperature* of

the cool supply air is kept constant while the amount of circulation is automatically varied. In the winter, or heating season, circulation is kept constant while the temperature of air delivered into the room is varied to suit.

The de-humidifier used cools the spray water by refrigeration within the apparatus itself. The sprays and warm water tank are located in the upper chamber as illustrated in Fig. 4, while the lower chamber contains the cool water tank and direct expansion Baudelot ammonia coils; the water of the sprays falling into the upper pan overflows through overflow pipes into the flooding trough below, the ends of the overflow pipes being carried below the surface and thereby water-sealed. Thus the upper chamber is not only separated from the lower one but has all connections between the two water-sealed.

Regulation of the amount of moisture retained by the air leaving the de-humidifier is obtained by controlling the spray water temperature; this is accomplished by a three-way mixing valve by-passing, in correct proportions, water from the upper tank directly to the suction line of the circulation pump where it is mixed with the cold suction water which (not having been by-passed) has flowed over the ammonia cooling coils. Thus, whenever too much cooling is being done the operation of this mixing valve raises the temperature of the cooling water and consequently the air, and vice versa.

LEGAL DECISIONS

License Fees for Inspection of Pipes.

A city ordinance required an annual inspection of all pipes and mains of gas, water, steam heating and other companies maintaining or operating such pipes and mains in the streets, avenues, and alleys of the city, imposing an annual license fee of $30 for each mile of pipes and mains. In proceedings for the reduction of the license fee it appeared that no regular inspection was made by the city other than that made by the police, fire, engineering, and street departments as incidential to their other duties, and that no extra expenses were incurred for such inspection, and that the cost of such inspection did not exceed $7.50 per mile. It was held that the amount fixed by the ordinance was excessive, and the city would not be permitted to collect more than $7.50 per mile for inspection. *In re* Pennsylvania Gas Co., Pensylvania Supreme Court, 101 Atl. 996.

Charges for Heating.

The Oklahoma Supreme Court holds, Guthrie Gas, Light, Fuel and Improvement Co. v. Board of Education, 166 Pac. 128, that an order of the corporation commission requiring that natural gas be furnished to the board of education of the city of Guthrie for heating the public school, at a rate different from and less than that charged to other consumers, is not by reason of the discrimination in favor of the public schools alone invalid. The board of education and the gas company entered into a contract under which the boards istalled a system of heating by natural gas in the public schools, and the gas company furnished gas to the board for heating purposes at a certain rate and maintained that rate for a considerable period of time. Thereafter the rate was changed to a different and higher rate at the request of the supply company from whom the local company obtained the gas and because the rate furnished to the board was discriminatory as compared with rates charged to other consumers, and not because the rate granted to the board deprived the gas company of a just return upon its investment. It was held that the evidence showing these facts was sufficient to justify an order by the Corporation Commission requiring a rate to the board of education different from and less than that charged by the gas company to other consumers in the absence of a showing that said rate fixed by the commission, in connection with the rates charged to other consumers, deprived the gas company of a just return upon its investment.

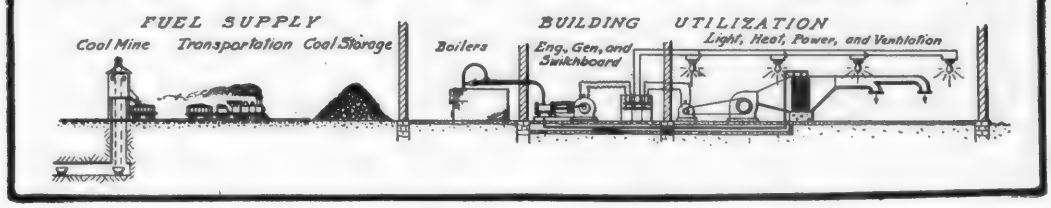
Parol Evidence to Supply Omissions in Contract.

The Michigan Supreme Court holds, Sparks v. Lord, 164 N. W. 490, that in a suit for the balance of the price of installing a heating system, where the written contract showed that in its preparation the degrees of temperature which the system was guaranteed to produce were inadvertently omitted from the schedule provided, parol evidence of a verbal agreement that the house was to be heated to 72° F. was admissible.

Death.

C. A. Blessing, Philadelphia, Pa., founder and owner of the heating and plumbing supply business conducted under his name, died at his home in Glenside, Pa., October 21. He was 75 years old. Mr. Blessing was a pioneer in the plumbing supply line, having patented the first one-piece, copper-lined bath-tub which was principally responsible for his success.

POWER PLANT ENGINEERING



Feed-Water Heating

As is well known, there are two main reasons for heating feed water: (a) to economize on fuel consumption and, (b) to prevent temperature strains on the boilers, due to the feeding of cold water. On account of the first consideration exhaust steam is utilized whenever possible and, because of the second, a high pressure make-up, carried through a reducing valve, is used where the supply of exhaust steam is not sufficient or is used for other purposes.

Owing to the serious troubles resulting from getting oil into the boilers, the closed type of feed-water heater was favored for a long time because this heater does not allow any mixing of the water and the steam. Thus exhaust steam containing oil can be used with impunity in a closed heater although the oil will coat the outside of the tubes in time and make the scraping of them necessary.

The common closed heater consists of a cast-iron or steel shell containing the brass or copper water tubes through which the water passes. The steam occupies all the space between the shell and tubes and these heaters are, therefore, sometimes termed "water-tube" heaters; they are usually placed on the boiler-feed pump discharge line and for this reason are also sometimes called "pressure heaters." Fig. 1 shows a heater of this type as manufactured by the Alberger Heater Company.

For the purpose of preventing the accumulation of scale on the inside of the water tubes, due to precipitation of the water while heating, the tubes are sometimes made spirally corrugated (as shown in the cut) may have a wire bent into a spiral shape placed on the inside, somewhat like the rifling of a gun barrel, or the tubes themselves may be bent into a long coil form, the idea of all these being to impart to the water a rotating scouring motion as it passes through the tubes so as to prevent the formation of scale.

ADVANTAGES OF CLOSED HEATERS

Closed heaters occupy less room than open heaters of equal capacity and are cheaper to install. Their efficiency in the transmission of heat to the water from the steam is not quite as high as the open heater and unless copper tubes are used they may become subject to electrolysis. Their chief recommendation is the fact of absolutely keeping oil out of the feed-water which, in some cases, is more important than 1% or 2% higher efficiency of heat transmission with the danger of oil.

ADVANTAGES OF OPEN HEATERS

With the exception of the oil danger, open feed-water heaters have a large number of desirable features the most important of which consist of (a) higher heat transmitting efficiency, (b) greater storage capacity of hot water ready for a sudden load on the boilers, (c) made entirely of iron they experience no trouble with electrolysis, (d) they remove scale and sediment from the feed water and (e) serve as a receiver for all sorts of drips, returns, trap discharges, etc., utilizing the heat contained therein.

The usual open heater consists mainly of a ribbed cast iron shell usually 3 ft. to 4 ft. square and 5 ft. to 7 ft. high. Into this the exhaust steam enters (after passing through an oil separator) and is confined within the shell; a small vent pipe is connected into the top of the heater to prevent its becoming air bound and to relieve the air separated from the heating water. The feed-water to be heated is then dripped or sprayed through the steam, condensing it, and the mixture falls toward the bottom passing through a filter and into the boiler feed pump suction line.

The water line in the heater is held up to a given level by a ball float which opens the

cold water make-up line whenever the returns or other sources of feed-water are not sufficient to meet the boiler demands. If too much water is brought back to the heater it overflows through a water-sealed overflow to the sewer. In Fig. 2 is shown a type of open feed-water heater, this being the Cochrane heater, made by the Harrison Safety Boiler Works.

FIG. 1—TYPE OF CLOSED FEED-WATER HEATER.

FEED-WATER HEATER AN ECONOMIC NECESSITY IN PLANT OPERATION

Viewed from any point the use of a feed-water heater is not only desirable but is an economic necessity to secure efficiency in plant operation. It must not even be looked upon as an additional item of cost for as a matter of fact, it will so reduce the work done by the boilers in ordinary cases as to make practical either the elimination of one boiler altogether or else a reduction in the size of boilers otherwise required without the heater.

For instance, assume a given installation, without a feed-water heater, with the feed-water coming in at 50° F. and using steam at 150 lbs. gauge. According to the steam tables there will be in the steam at 150 lbs. gauge 1195 B.T.U., while the water at 50° F. contains 18 B.T.U. The difference, or 1195—18= 1177 B.T.U., is being supplied by the boiler to every pound of steam generated.

With a feed-water heater of open type installed, the feed-water probably could be raised to 210° F. before entering the boiler, resulting in a saving of 210°—50°, or 160°, which means 160 B.T.U. that the boiler does not have to furnish on each pound of steam generated or 160/1177 = 13.6% saving.

This means a reduction of about one-seventh of the total boiler load so that, where seven boilers were required *without* a heater, six will do the same work *with* the heater. Or, another way, if 100 HP boilers are required *without* a heater 86 HP boilers can be used *with* a heater and perform the same work; that is furnish the same number of pounds of steam at the same pressure.

ECONOMY FOR VARIOUS INITIAL AND FINAL TEMPERATURE OF FEED WATER

The following table has been computed for a steam pressure of 70 lbs. gauge and shows the saving for various initial and final temperatures of feed water.

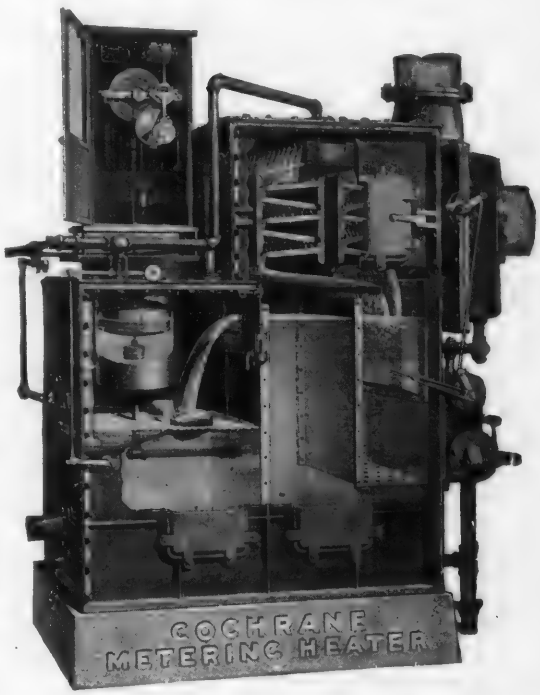


FIG. 2—TYPICAL OPEN-FEED WATER HEATER.

Initial Temp. Feed Deg. F.	Temperature to which Feed is Heated							
	100	120	140	160	180	200	220	300
	SAVING IN PER CENT							
35	5.53	7.24	8.95	10.66	12.38	14.09	15.81	29.34
40	5.12	6.84	8.56	10.28	12.00	13.73	15.45	28.78
45	4.71	6.44	8.16	9.90	11.62	13.36	15.09	28.22
50	4.30	6.03	7.76	9.51	11.24	12.98	14.72	27.67
55	3.89	5.63	7.37	9.11	10.85	12.60	14.35	27.12
60	3.47	5.21	6.96	8.72	10.47	12.22	13.98	26.56
65	3.05	4.80	6.56	8.32	10.08	11.84	13.60	26.02
70	2.62	4.38	6.15	7.92	9.68	11.45	13.22	25.47
75	2.19	3.96	5.73	7.51	9.28	11.06	12.84	24.92
80	1.76	3.54	5.32	7.11	8.80	10.67	12.46	24.37
85	1.30	3.11	4.90	6.70	8.48	10.28	12.07	23.82
90	0.89	2.68	4.48	6.28	8.07	9.98	11.68	23.27
95	0.45	2.25	4.05	5.86	7.66	9.47	11.29	22.73
100	0.00	1.81	3.62	5.44	7.25	9.07	10.88	22.18

The saving effected by a feed-water heater is a true saving although its thermal efficiency is not as high as some other feeding devices; in this way it seems somewhat contradictory because it is seldom that a device 100% thermally efficient actually *saves* less than an apparatus of much lower efficiency. Such is the case, however, when the feed-water heater is compared to the injector; this is owing to the fact that the injector utilizes heat directly from the boiler and puts back only the heat which it takes out while the feed-water heater utilizes heat from the exhaust steam which would otherwise be thrown out into the atmosphere and wasted. Thus while it may be less efficient *absolutely* it is much more economical practically.

TYPES OF COMBINATION HEATERS

Besides the simple feed-water heater there are manufactured heaters in combination with other accessories; in fact, most open heaters are combined with oil separators. One of the most interesting and successful combinations is handled by the Standard Steam Specialty Company and is known as the Utility exhaust muffler, oil separator, return tank, pump governor and feed-water heater. A view of this is shown in Fig. 3, the general form being that of a large cylinder.

The exhaust steam enters the tank through the inlet and has its velocity greatly reduced in the first chamber, which is called the expansion chamber. In passing through this chamber the direction of flow is changed 90° and most of the entrained water is thrown out. It then passes through a series of removable chain baffle impinging surfaces which are so arranged that the course of the stream is thoroughly divided and broken up and yet are kept with such free area that practically no back pressure is created.

The oily emulsion and the oil in the exhaust are precipitated by gravity to the bottom of the oil separating compartments and the purified and dry exhaust steam then leaves by way of the outlet.

The water heating compartment is entirely separate and has no connection to the oil separator portion. The purified exhaust steam is allowed to enter the water compartment through a valved connection to the exhaust line and is brought into direct contact with the water. Clean returns are connected into the heater through a sprayer in the steam

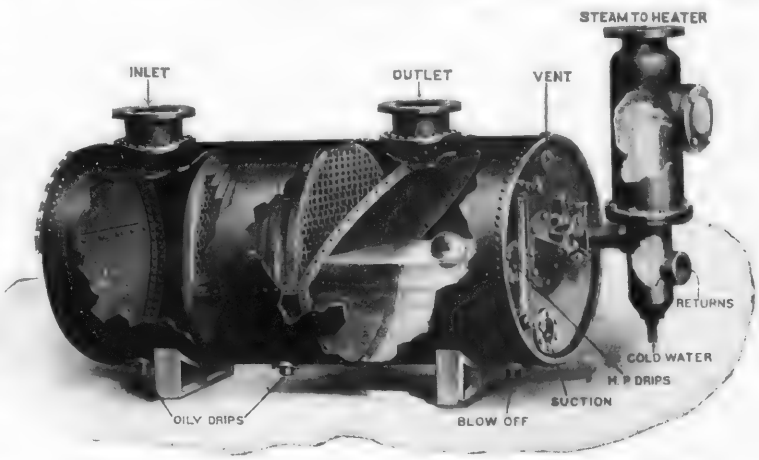


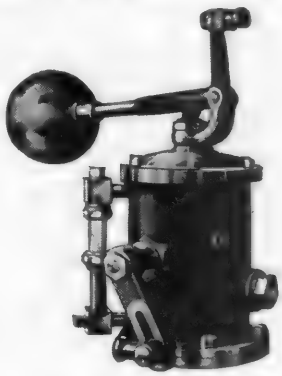
FIG. 3—COMBINATION FEED-WATER HEATER AND OIL SEPARATOR.

connection so that the returns and makeup water can be heated to around 212° by direct contact with the exhaust steam.

Another advantage is that by closing the steam valve to the feed-water side the oil separator may be still kept running regardless of any repairs which may be necessary to the feed water mechanism.

Notes

The steam pump speed governor, made by the Mason Regulator Co., Boston, Mass., is to the direct-acting steam pump what the ordinary ball governor is to be steam engine. It derives its motion from some reciprocating part of the pump and controls a balanced valve placed in the steam pipe, thereby ex-



MASON STEAM PUMP GOVERNOR.

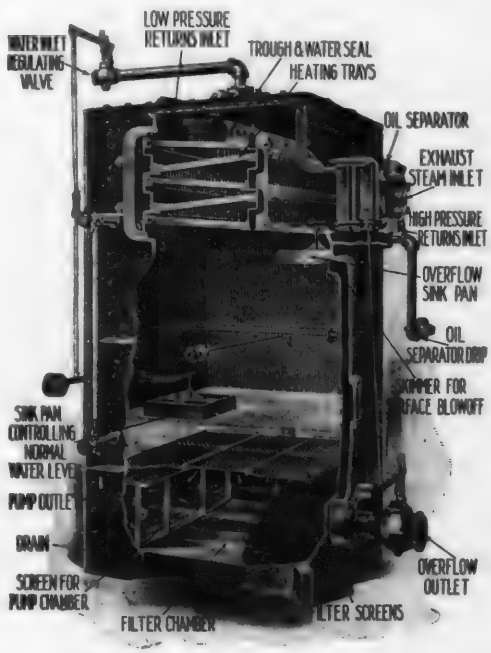
actly regulating the amount of steam to the requirements of the pump, and automatically maintaining a uniform speed, regardless of any variation of steam or load. By the use of a key the speed of the pump can be changed, if desired, while the pump is in motion. These governors are used on direct-acting steam pumps (both single and duplex), also on all classes of flywheel pumps, including vacuum pumps, air compressors and ice machines.

Pump suction strainers are desirable for all pumps and the H. Mueller Mfg. Co., Decatur, Ill., claims to have a particularly good design. The strainer body is made of cast-iron, galvanized, and has screw ends. The screen is made of perforated sheet brass, is cylindrical in shape and is supported in a perpendicular position in the body top by a brass spring wire stem which rests upon a ring in the bottom of the body. The bottom is a plug which can be removed to empty the sediment pocket without the screen coming out. The ½ to 2 in. sizes, inclusive, are furnished with a screen having 361 perforations to the

MUELLER PUMP SUCTION STRAINER.

square inch, and 2, 2½ and 3 in. sizes with a screen having 144 perforations to the square inch. In each instance the combined area of the perforation is about twice the area of the pipe connection.

The feed-water heater made by Warren Webster & Co., Camden, N. J., consists of a cast-iron receptacle in which cold water and exhaust steam are brought into direct contact. This heater is designed upon the standard Webster principle—an exhaust steam feed-water heater, in combination with a filter and precipitating chamber. The heater is



WEBSTER FEED-WATER HEATER.

provided with an oil separator, which removes the oil present in the exhaust steam; with automatically-regulated water-supply and overflow; with quick-opening drain-valve or blow-off; with sealed outlet for the heated and purified water fed to the boiler feed-pumps; with charging and cleaning doors for the filter; with removable trays; with combination vent and inlet air-valves; with gauge-glass, and other fixtures.

The materials used in its construction are cast-iron for the shell and copper and brass for the valves and fixtures; each of which resists the destructive action of impure waters. The large heating chamber—upper section of the heater—is provided with perforated copper trays for the distribution of the water. The entire valve-gear, automatically controlling the water supply and overflow, is of brass. The exposed parts of the heater-shell are protected by heat-resisting graphite paint and all outside brasswork is brightly finished.

The War and the Heating Engineer

Call for Service Overseas.

Steam and hot-water fitters are wanted for early service overseas to serve with the enlisted Ordnance Corps, National Army. These men are needed at once. The call has gone out for steam-fitters between the ages of 18 and 40, who want to do their bit and who know their job. Modern war it is pointed out is a tremendous business, and the army that wins is the army which has the best equipment and the best men. The men are over there now—they are ready to go ahead, but they still need experts in our line to repair and maintain their equipment. There is a fine chance for every man who wants to help. Write to the Chief of Ordnance, War Department, Washington, D. C.

Skilled Workers for the Air Service, United States Army.

The Air Division of the War Department announces that more skilled workmen are needed to serve behind the lines abroad. These men must be recruited continuously, beginning immediately, until March 31. They will be employed in bringing up supplies, ammunition, food, clothing, to construct and maintain the airdromes for housing the planes and quartering the men. The Air Service calls for the following kinds of skilled workers, arranged in the order of men needed:

Chauffeurs
Auto Mechanicians
Automobile Engine, Repair Men
Office Clerks
Carpenters
Propeller Makers (Airplane)
Riggers (Airplane Assemblers)
Telephone Linesmen
Tool Makers
Radio Operators
Electricians
Instrument Repair Men
Cooks
Coppersmiths
Armorers (Machine Gun Repair Men)
Sail Makers
Photographers
Machinists
Blacksmiths
Motorcycle Repair Men
Stenographers
Cabinet Makers
Draftsmen (Mechanical)
Magneto Repair Men
Metal Workers
Automobile Engine (Testers)
Rope Riggers (Cordage workers)
Vulcanizers
Welders
Lithographers
Packers
Telephone Operators
Motorcyclists
Plumbers
Painters
Tailors
Gas Works Employees
Buglers
Moulders
Pattern Makers
Telephone Adjusters
Barbers
Truck Masters
Brick Layers
Cobblers
Propeller Testers (Airplane)
Boat Makers
Saddlers

Applicants must be physically sound, white, and from 18 to 40 years of age.

After enlistment the men will be sent to a camp for several weeks of military training. Squadrons are being formed continously. Enlistments should be sent to the Volunteer Bureau, 119 D Street, N. E., Washington, D. C., marked "for service in the Aviation Section of the Signal Corps."

Officers Wanted for Civil Engineer Corps, U. S. Naval Reserve Corps.

The bureau of Yards and Docks, U. S. Navy Department, announces that an examination will be held at the Bureau of Yards and Docks, Navy Department, Washington, D. C., to establish a list of eligibles for enrollment in the Civil Engineer Corps of the United States Naval Reserve Force. This examination will close at noon of December 31, 1917.

To compete in this examination it is only necessary for the candidate to address a letter to the Reserve Examining Board giv-

ing full information as to his education and experience with testimonials and references.

A descriptive circular giving detailed information of the requirements for this examination will be sent upon request to the Chief of the Bureau of Yards and Docks, Navy Department, Washington, D. C.

Candidate must be an American citizen and must be an engineer in active practice of the profession of civil, electrical or mechanical engineering or some business directly connected with these professions.

The age and experience requirements are for Ensign, not less than 24 years of age with not less than two years of active professional practice; for Lieutenant (junior grade) not less than 27 years of age with not less than five years of active professional practice; for Lieutenant, not less than 30 years of age with not less than seven years of active professional practice, during at least three years of which candidate must have had responsible charge of work as principal or assistant.

Enrollments are for a period of four years or during the existence of a war or national emergency. Except during a war or national emergency officers are only given active duty at their own request and then for short periods.

Pay and allowances of officers amount to approximately as follows: Ensign, $2100 per annum; Lieutenant (junior grade), $2500 per annum; Lieutenant, $3100 per annum.

There is an additional allowance of $150 per annum for uniforms.

Activities of the Shipping Board and Emergency Fleet Corporation.

Thirty-five thousand shipworkers are already wearing badges bearing the inscription "War Service Ship Building, U. S. A.", states a bulletin issued by the Chamber of Commerce of the United States. It is further stated that 1,000,000 tons of shipping will be turned out between now and March 1.

Thirtieth Engineers, Gas and Flame, Being Organized.

The first battalion of American soldiers to met offensively the gas and fire which the enemy introduced in warfare is being organized as the Thirtieth Engineers, Gas and Flame, with headquarters at Camp American University, Washington, D. C.

The battalion is being recruited from the ranks of such civil professions and trades as chemical and mechanical engineering, explosive and gas manufacture, plumbing and carpentry, and similar trades, and an exceptionally high grade of talent is volunteering.

Major E. J. Atkisson, Corps of Engineers, a graduate of West Point and of Cornell, is in charge of organization. He has specialized in mechanical and electric enginering, was formerly director of Electrical and Mechanical Engineering, U. S. Army School, and was Superintendent of Locks, Panama Canal.

It is announced that there is opportunity for a limited number of enlistments for the following classes of men: chemists, gas engineers, plumbers, electrical experts, pipe-fitters, interpreters, mechanics, chauffeurs, explosive experts, cooks, gas experts, blacksmiths, carpenters, clerks and muscular, quick-thinking, resolute men, between the ages of 18 and 40 years, for pioneer soldier service of high character. Major Atkisson has announced that any man possessing the necessary qualifications may volunteer at any recruiting station in the country by asking to join the Thirtieth Battalion Gas and Flame, forming at Washington.

Chamber of Commerce Advocates Further Price Control.

The Chamber of Commerce of the United States has gone on record as favoring additional legislation for price control of materials needed for the conduct of the war, as well as all materials affecting the public interest. It is the sentiment of the Chamber according to a referendum vote, that authority to control prices should also extend to raw materials and finished products. It was recommended that authority to control prices should be administered by a small executive body appointed by the President. The National Chamber has already gone on record as endorsing the principle of "no profit interest" in the war.

Government Contracts.

James Smyth Plumbing & Heating Co., Spokane, Wash., has been awarded the contract for the installation of plumbing and heating systems in the $25,000,000 ship building project at Hog Island, near Philadelphia. The contract will also include the

installation of plumbing and heating systems in ships to be constructed in the ship yard, to the value of $250,000,000.

F. A. Clegg & Co., Louisville, Ky., installed the heating equipment in the 68 buildings comprising the hospital unit at Camp Zachary Taylor, near Louisville. The installation included 1600 radiators, totaling 80,000 sq. ft. of heating surface. Steam is supplied from a central station. The work was in charge of A. W. Clegg.

American District Steam Co., No. Tonawanda, N. Y., had the contract for installing the $100,000 heating plant for the base hospitals at the Tacoma army camp. All of the nearly 100 buildings of the base hospital unit are heated from a central plant.

At Fort Riley what is described as the leargest steam heating plant in the country has been installed at a cost of $1,000,000. The laundry will employ 250 women and 150 men working in two shifts of eight hours each. The laundry requires 200,000 gal. of water per day and the heating plant 300,000 gal.

Underground Specialty Co., New York, has received an order from the Emergency Ship Building Corporation for thousands of feet of Staten's high-efficiency sectional conduit for installation in the large ship-building plant now building at Bristol, Pa. The plant will include a housing proposition for the workers, also high-pressure lines for mechanical work. The type of conduit used will carry from one to four pipe lines. The work is being done by the William Gordon Corporation, New York.

On Government Work.

Clarence M. Woolley, president of the American Radiator Co., Chicago, Ill., has been appointed a member of the War Trade Board. In a recent announcement by the War Trade Board, it is stated that it is believed Mr. Woolley's services "will be especially valuable on the import side of the board's work because of his familiarity with the questions involved."

George W. Martin, president of the National District Heating Association, has given his services to the government in designing the heating equipment for the new large shipbuilding plants being erected in the vicinity of New York.

Walter S. Timmis, New York, has been serving as consulting engineer for the heating equipment of Camp Upton at Yaphank, L. I. W. H. Driscoll, of New York, representing the Thompson-Starrett Co., which had the contract for the mechanical equipment at Camp Upton, has had direct charge of the installation which proved a task of extraordinary magnitude.

W. F. Goodnow, of the New York branch of the American Radiator Company has been engaged in government work, making frequent trips to Washington for conferences on work in his line. Other frequent visitors to Washington on government work are Homer Addams, manager of the New York branch of the Kewanee Boiler Company, and D. Rait Richardson, of the Richardson & Boynton Company, New York.

Liberty Loan Subscriptions.

Results of the Liberty Loan drive in the metal and allied trades division in New York showed a total of $42,218,250. The machinery and machine tools division subscribed $12,888,650. Among the individual subscriptions in New York and elsewhere were the following: J. H. Williams Co., Brooklyn, $51,000; American Radiator Co. (New York branch), $50,000; National Tube Co., Pittsbugh, $2,200,000; American Radiator Co. (Buffalo branch); $100,000; Jones & Laughlin Steel Co., Pittsburgh, $2,000,000; and Youngstown Sheet & Tube Co., $2,725,000.

Coal-Saving Hints for Power Plant Owners and Managers.

A bulletin issued by the Committee on Coal Conservation of the Chamber of Commerce of the United States contains the following suggestions for conservation in the use of coal by owners and managers of power plants.

Reconsider the advantage of buying heat and power from a specialized plant that makes nothing else and can afford the investment and supervision that gets a maximum of value out of each pound of coal; in some localities hydro-electric power may be available.

Find the nearest source of coal that will meet the requirements.

Give to the power plant and its personnel recognition and encouragement.

Seek to increase skill and efficiency in the men who handle the coal.

Put the fuel-using equipment into as perfect a condition as possible.

Install simple and convenient means by

which the fireroom force may see results, scales for weighing fuel and ash, etc.

Endeavor to run boilers in service at their capacity.

Provide water that is free from scale by using, when necessary, water-treating devices if the plant is large and special feed-water heaters in small plants.

Reduce loss of heat after it is generated, see that boiler surfaces and steam pipes are properly covered, etc.

Obtain expert advice.

Burners of fuel are urged to strive after the record of present possibility of obtaining 1 H.P. on 1 lb. of coal per hour.

CORRESPONDENCE

A Steel Stack Problem.

In a recent letter to Harold L. Alt a reader states: "Having been a member of the American Society of Heating and Ventilating Engineers and having read your recent article on chimneys, I am taking the liberty of writing you to see if I am right in assuming that we would obtain bad draft in a steel stack which is erected on the outside of a building, and has the following conditions:

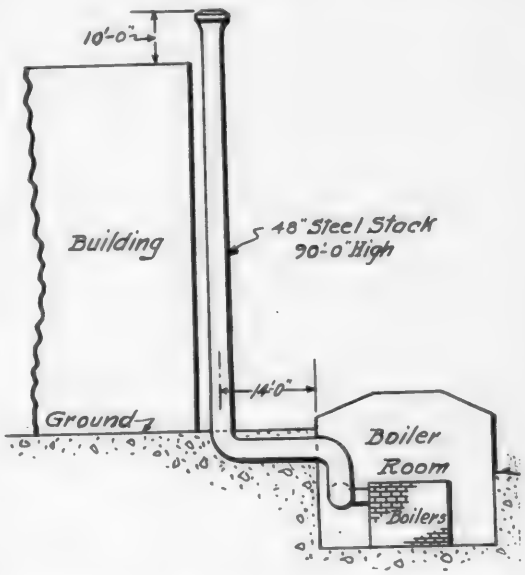
"The stack was built 48 in. dia. 90 ft. high and was figured to take care of three boilers, down-draft, Hawley-type grate, the upper grate being 32 sq. ft. and the lower grate 32 sq. ft., or a total of 64 sq. ft. in each boiler. The smoke collar at the back of each boiler is 26 in. in diameter. Only two boilers were installed, one being omitted for future extensions. We calculated the requirements for the two boilers at 36 in. dia. 90 ft. high.

"As this stack is exposed to outside weather, and has no lining inside or outside, don't we have by this excessive diameter a chilling of the stack gases and a strata of heavy air trying to fall to bottom of stack? This excess space inside of chimney must chill as the temperature of this stack, halfway up, is not hot, only warm.

REPLY BY H. L. ALT.

The conditions of draft in a stack erected as you suggest would be such as to doom the installation to failure in the production of 100% rating from the boilers.

While your inquiry does not give complete information as to horsepower to be developed and kind of coal to be used it is assumed from catalogue ratings on steel down-draft boilers that the full rated horsepower will be about 120 H. P. per boiler,



CONDITIONS OF STEEL STACK PROBLEM.

making 240 H.P. to be developed now and 360 H.P. later, when the third boiler is installed.

In figuring the stack the writer—assuming common Pennsylvania bituminous coal would be used —would employ the following figures:

At 5 lbs. of coal per H.P. the rate of combustion on the upper grate (approx. 2/3 of the coal being there consumed) would be $\frac{5 \times 120 \times 2/3}{32} = \frac{400}{32} = 13$ lbs. per sq. ft. of grate area.

Then the draft loss in the fire would be about	0.15 in.
The draft loss in the boiler at 100% rating would approximate that of a H.R.T. boiler or	0.30 in.
Assuming 30 lineal feet of steel breeching $0.01 \times 30/100$	0.03 in.
Four 90° bends between boiler and stack 4×0.05	0.20 in.
Loss in stack (assumed)	0.20 in.
Allowance for contingencies	0.10 in.
Total friction to be overcome about	0.98 in.

With an *average* stack temperature of 500° F. and at sea level this would take a stack of about.... 110 ft.
Stack loss of 0.20 × 110/100 = actual stack loss of..... 0.22 in.
Increasing estimated friction of 0.98 to 0.98 + 0.02 =..... 1.00 in.
Height of stack at 500° F. for 1.00 in. about..... 112 ft.
Total pounds of coal for—
1 boiler 600; pounds of gas..... 2¾
2 boilers, 1200; pounds of gas..... 5½
3 boilers, 1800; pounds of gas..... 8½
Size of stack to handle two boilers (5½ lbs. gas per second).. 30 in. dia.
Size of stack to handle three boilers (8½ lbs. gas per second).. 38 in. dia.

Therefore by *this* reasoning the stack for three boilers could be most economically sized if made 38 in. dia × 112 ft. high. But the stack under consideration is to be made 48 in. dia. (which will reduce the stack friction) so some of the height may be cut down, as the height is always dependent on the total friction to be overcome.

Looking on the curves for steel stacks to find the friction loss per 100 ft. of height for a 48 in. dia. stack handling 8½ lbs. of gas per second it is found to be very, very small; in fact, only about 0.016 in. Therefore this will reduce the total friction from the amount previously computed by 0.22 — 0.016, or 0.204.

1.00 — 0.20 = 0.80

Then the height for 500° F. at sea level need be only about 90 ft. or about 100 ft. high at 2000 ft. altitude.

But the gases are constantly cooled in an unlined steel stack to a great degree. Thus, for a 48 in. × 90 ft. high stack is as follows:

4 × 3.14 × 90 = 1129 sq. ft. outside area.

If 3 B.T.U. per square foot per degree are assumed as the approximate radiation factor, then for an *average* of 500° stack temperature and zero outside the total B.T.U. loss per hour equals

1129 × 500 × 3 = 1693500 B.T.U.
28225 B.T.U. per min.
470 B.T.U. per second

With 5½ lbs. of gas handled per second the stack loss of temperature (specific heat of air being 0.2375) will be $\frac{470}{5.5 \times .2375} =$ 312° drop. To maintain an average of 500° half the drop must be added to the average or 500 + 312/2 = 650° entering temperature of gas and 500 — 312/2 = 344° leaving temperature of gas.

With only one boiler running the entering temperature would have to be even higher. What would actually happen would be that the entering temperature would probably be about 500° or 550° at the highest and the average only 400° or 350° which would produce a theoretical draft of less than that computed for 500° average.

Considering the fact there is some elevation to be considered in your vicinity and that the average stack temperature will be reduced over 100° from the temperature of the gases leaving the boiler, it is fair to assume that 100% boiler rating cannot be developed, although some 60% or 80% might possibly be produced. For the conditions given, a lined steel stack, an interior steel stack or a brick stack would be much better. In any case a slightly higher stack of less diameter is suggested.

Back-Draft in Chimney.

EDITOR, HEATING AND VENTILATING MAGAZINE:

I am enclosing a sketch of a basement flat where we are unable to use the grate in the mantle owing to the fact that the draft backs down the chimney—the chimney in question has three flues in it, one leading to the mantle in basement the other two leading to the two flats above; the draft in the flues from the flats above is all right. At first I was of the opinion that the hot-water boiler on the other side of the building was the cause as there is no outside air inlet to supply that demanded for necessary combustion and the currents of air under the doorways led to the furnace room, but opening doorway (D) to boiler room from outside did not stop draft down mantle flue; all radiators in basement are on ceiling.

What would you attribute as the cause of the condition and what remedy would you suggest? Would a hood over the top of the chimney, combining the three flues in one, with a somewhat contracted area at outlet of the combined three flues, accomplish the desired result?

J. H. C.

Toledo, Ohio.

There are several features shown in our correspondent's sketch which might help to produce the back draft in the chimney flue as described. In the first place, the chimney is an outside one with one side and two ends exposed to the outer temperature, which will, of course, have a tendency to cool the flues and cause a reverse draft unless heat is supplied at the

bottom more rapidily than it is radiated on the way up.

In the second place, the other flues in the same chimney are all connected to fireplaces which are undoubtedly used only intermittently, resulting in the chimney getting very cold and so reducing the temperature of the air in the flue that its weight becomes greater than the air in the house thus producing a reverse draft.

Third, the air supply for the boiler must be taken to a great extent out of the basement, there being but one door and window in the boiler-room which would hardly provide sufficient leakage to supply the necessary air for combustion.

Fourth, the Room "A" opens directly into a stairway, which may be assumed as going straight up to the top of the building and whose action will be quite like a chimney if any opening exists at the top—such as a partially open window, a ventilator, or door out onto the roof.

It is believed that the combination of all the above items produces a slight reduction of the air pressure in the basement, resulting in the back draft complained of. The correspondent displayed good reasoning in trying the experiment of opening the outside boiler-room door "D" but if this door happened *at that time* to be on the lee side of the building it might have made conditions worse instead of better. With the wind blowing *against* the boiler-room side of the house it is thought that no trouble will be experienced with this flue, especially if the doors between Room A and the boiler room should be left open.

It is not likely that the radiators placed on the ceiling of the basement will affect the matter at all nor is it thought that the correspondent's suggestion of capping all the flues at the top into a contracted opening, as shown in Fig. 2, will give any relief. The usual result of such procedure is the pulling down of the smoke from the other flues into the reversed flue resulting much more disagreeably than when only cold air is drawn down as at present.

As near as can be judged from the sketch, the most satisfactory solution of the trouble will probably be found in providing a ventilator top of the positive suction type and connected to the reversed flue alone. This will not interfere with the action of the two other flues now said to be working properly and the gain made is all applied to the flue giving the trouble. Also

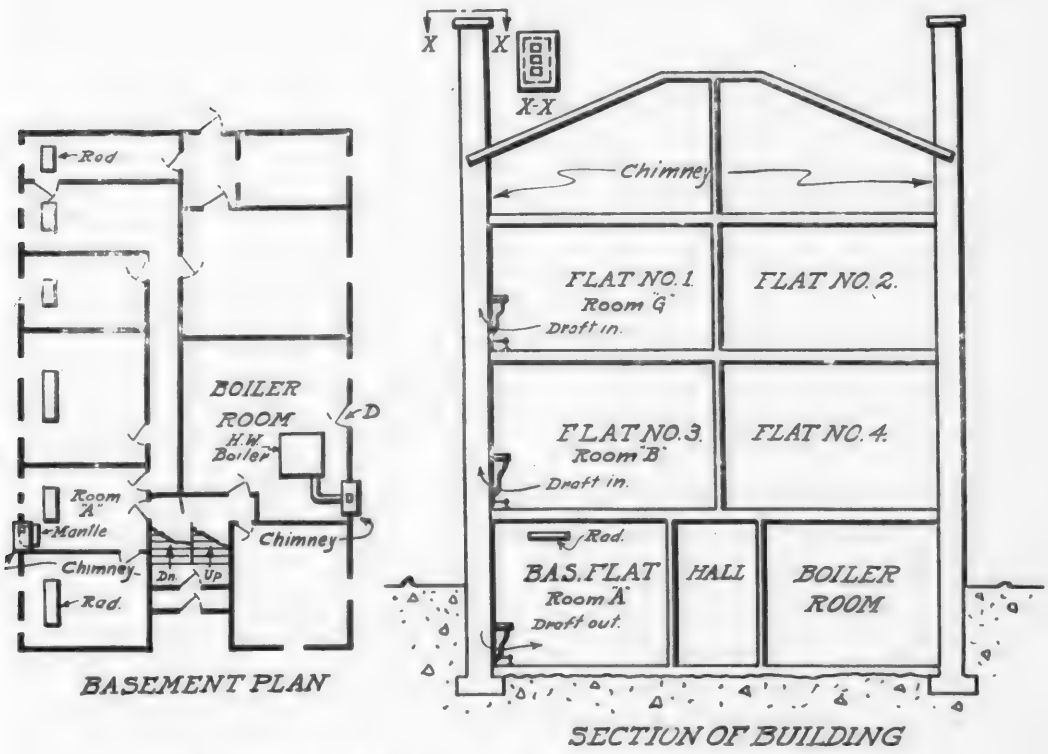


FIG. 1—SKETCH OF BUILDING WITH BACK-DRAFT IN CHIMNEY.

investigate the matter of the draft going up the rear hall stairs and close any opening at the top of same. Take a good cigar with you and follow the smoke until you find out where the air is going—for air which *comes in* down the flue must *go out* somewhere.

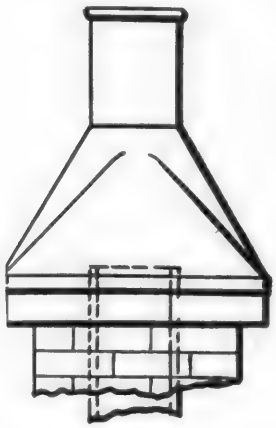


FIG. 2—POOR WAY OF CAPPING FLUES INTO A CONTRACTED OPENING.

Also look into the matter of making the boiler-room door fairly air tight and, if necessary, place a small register face in the outside door panel of door "D" to supply the air necessary for combustion. In conclusion, it might be said the reverse drafts in outside chimneys from fire-places are rather common due to the chimney getting chilled between times when the fire-places are out of use.

Examination for Heating and Ventilating Engineer.

Minneapolis, Minn.—The Civil Service Commission of Minneapolis will hold an examination, in January, for the position of Mechanical Engineer, to take charge of the work of the Board of Education in reference to laying out plans for mechanical equipment for the school buildings, in connection with the Board's architectural department. Inquiries will receive prompt attention. The salary has been tentatively fixed at $2400.00 per year. Civil Service Commission, 111 City Hall, Minneapolis.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Cantonment Heating and Ventilation Discussed By Illinois Chapter.

The heating and ventilation of army cantonments were taken up at the November meeting of the Illinois Chapter which was held at the Engineers' Club. November 13. Dr. Arthur R. Reynolds, formerly Chicago health commissioner, who was the first speaker, had some warm words of praise for the astonishing progress made by the government in the construction of the camps. He advocated the two-men-in-a-room plan for cantonments in order to insure healthful conditions.

William J. Mauer, the next speaker favored the army squad type of barrack, each building to house eight men, as described in THE HEATING AND VENTILATING MAGAZINE for November.

It was voted to discuss, at future meetings of the chapter, the papers that had been prepared in past years dealing with standards for heating and ventilation.

Nearly 40 members and guests were present.

Kansas City Chapter Urges Fuel Conservation in the Home.

A timely discussion of ways to save fuel was the feature of the November meeting of the Kansas City Chapter, held at the University Club, Kansas City, November 9. Upon completion of the business session President De Boos turned over the meeting to F. J. McMorran, who was chairman for the evening.

Speaking to the subject of "Fuel Conservation in the Home," W. N. McIntyre took up the proper handling of hot air and steam heating plants in residence and apartment house installations. He stated that the economical operation of the plans was dependent upon three things: keeping the fire surface clean, maintaining the proper draft and putting coal on the fire at the proper time. In maintaining the proper draft the air leakage around the furnace must be stopped and the proper handling of the drafts carefully followed. The efficiency of the furnace is greater when the coal is burned slowly than when it is forced, and the proper size of grate must be installed to insure proper rate of burning and a comfortably heated house.

F. A. DeBoos followed with a paper on the same subject. He showed the importance of keeping the air from outdoors from entering the basement, thus cooling the floors and basement generally. He advocated weatherstripping all windows, but this was the subject of some discussion as affecting the ventilation of the home. He emphasized the importance of proper draft and the effect of a dirty flue as obstructing this. The proper size of the furnace to secure the required amount of heat with the most economical coal consumption was discussed. He added a list of "Do's" and "Don'ts" on good furnace operation that brought forth considerable discussion. It was agreed that this subject of proper operation was one in which the Chapter could take an active part and it is their intention to work out a series of suggestions along this line to place before the home-owners of Kansas City. This work is to be carried on by the publicity committee, of which John Pease is chairman, the other members of the committe being Benjamin Natkin, F. A. De Boos, John H. Kitchen and F. A. Griffin, Jr.

The second subject for the evening was the "Heating and Ventilation of Moving Picture Shows, Theatres and Churches." Mr. McMorran opened the subject with a paper on the standards of heating and ventilating in public and semi-public buildings as worked out by the Society. These standards are given as minimum requirements and cover the proper amount of floor space, the proper amount of air and the proper change of air per person. E. A. Cline followed with a paper on the split system of heating for such buildings. He outlined the method of arranging inlet and exhaust ducts, fans and heaters and explained the method of taking care of certain problems occasioned by the stage and raising curtain. Discussion of the solution of these problems ensued and was followed by a paper by R. L. Dunlap on the furnace fan system of handling such buildings. The conditions where the heating problem and where the ventilating problem controlled the size of the plant were outlined and some details of installations given.

A well-gotten-up chapter programme for 1917-1918 has been issued by the Kansas City Chapter, containing, among other things, a list of topics to be presented throughout the winter, at the chapter meetings which are held the first Friday of each month. For the December meeting the topics were wind leakage and hot water heating for domestic purposes. The other topics are as follows:

January 4, 1918: "Heating and Ventilating Army Camps and Cantonments," B. Natkin, chairman. (Mr. Natkin designed part of the heating plant at Camp Funston, erected under the supervision of Lieutenant Foster and installed by F. J. Sellers).

February 1, 1918: "Heating and Ventilation of Hospitals" and "Comparative Costs of Heating with Different Kinds of Fuel," Walter E. Gillham, chairman.

March 1, 1918: "Cooling and Refrigerating Systems," F. A. De Boos, chairman.

April 5, 1918: "Heating and Ventilating of School Buildings," John H. Kitchen, chairman.

May 3, 1918: "Comparison of Hot Water, Vacuum and Vapor Vacuum Sytems of heating," John Pease, chairman.

The membership list contains forty names, with five members in military or naval service, as follows: C. A. Bennett and Leslie Byson, at U. S. Navy Yard, Puget Sound; F. Chockley, in Engineers' Corps, Fort Sill, Okla.; B. D. Foster, lieutenant; and F. C. McIntosh, with the Sixth Nebraska Infantry at Fort Deming N. M.

The chapter tendered a luncheon on November 19, at the City Club to H. W. Booth, Kansas City manager of the United States Radiator Corporation, who was leaving for Chicago to take charge of the company's Chicago branch. Mr. Booth was succeeded by H. M. Hillman, who up to that time had been connected with the company's New York branch.

New York Chapter Hears About the Fuel Situation.

Some first-hand information concerning the fuel situation in the East and the urgent need of awakening the public to ways in which coal was being wasted held the attention of a large gathering at the November meeting of the New York Chapter, held November 19, in the rooms of the Building Trades Club.

The principal speakers were Arthur F. Rice, commissioner for the Coal Merchants' Association of New York; William M. Mackay, George D. Martin, president of the National District Heating Association and Perry West.

Mr. Rice stated that the normal consumption of coal in New York during the heating season was 6,000,000 tons, or 30,000 tons per day. He said there was at present

an inordinate demand for coal due to the large increase in the number of industrial plants, which was accompanied by a car and labor shortage.

He suggested the resizing of coal so that it would not be necessary to have so many separate storage bins for the various sizes. Almost all coal entering New York comes by boat and it would relieve congestion if stove and chestnut, for instance, could be stored in the same bin, the same applying to No. 1 and No. 2 buckwheat.

The lack of sufficient storage room for coal, he said, in large office buildings, is a most serious matter, it being quite common to find an office building with room for but one day's supply. Many hotels, also, have to be supplied daily.

He said one effect of coal price regulation by the government was to make steam coal abnormally high as there were no restrictions on the prices of the steam sizes. He thought the price of soft coal would have to go to $3.00 per ton because, he claimed, the government went too far in reducing this price. The price of anthracite, he said, was fixed higher than was expected, although he considered that the domestic sizes are not too high.

As a matter of fact, he said, chestnut is being used on buckwheat contracts, due directly to the lack of restrictions on the price of the steam sizes.

Mr. Rice then took up the many ways in which heat and light is wasted in hotels and office buildings. He also spoke of street lights he had seen burning at 8 a. m. A campaign of education is needed, he said, among small consumers.

W. M. Mackay said that some churches had arranged to hold their week day meetings on the first and third days of the week only so that the heating plants could be shut down the remainder of the week. He also recommended a lower temperature in the schools. He considered that damping the fire at night was not ordinarily an economical proposition. Where draft and grate permit Mr. Mackay recommended the burning of cheaper grade of coal.

George W. Martin, the next speaker, said that the National District Heating Association is working up a set of rules for conserving steam to be sent out to consumers generally. He recommended the appointment of a committee to prepare similar rules to be turned over to the Building Managers' Association.

Americans, he said, practice great wastefulness in the use of heat and light. Great clusters of lights will often be found burning in broad daylight.

On the matter of intermittent heating his own observation was that under some conditions the heating plant can be shut down and coal saved thereby. He cited the case of a large department store in which the night temperature had risen to 85° before the practice was adopted of shutting down at night.

We do not properly educate firemen, he added, and sometimes the building engineer is to blame for fuel waste. He instanced one case where the pressure always went down during the cleaning of the fires. It was suggested that the refrigerating plant might be shut down during that period. This was done with satisfactory results, but the engineer had never thought of doing it.

Perry West said the engineering department of the Newark Board of Education was sending experts around instructing the firemen in the public school plants. He suggested that the present was a very good time for getting away from "hothouse" standards of heating.

In addition to practicing economy, he said, it is important to eliminate unnecessary demands for heat. In this connection he urged no mechanical ventilation in the early Fall and Spring, the cutting off of heat in stairways and corridors except in extreme weather, consolidating the activities of the school classes, and perhaps eliminating some of such activities; and adjusting the human elements, that is, assembling the poorly-clad children in such a way that they could be in the warmer rooms.

Mr West said one important source of fuel economy was to keep the fires properly proportioned to the load. In this connection it is good practice to have dampers on the boilers in addition to the automatic dampers. He said Newark had saved $7500 in one year through regulation of the fires, or 25% of its total fuel cost for the year.

He urged the graduating of the temperature according to the outside conditions and suggested the following scale depending somewhat on the humidity and "rawness" of the outdoor air.

Outside Temperature Deg. F.	Temperature of Air Entering Room Deg. F.
0	70
30	60
40	64
50	62
60	60

Arthur K. Ohmes, discussing the topic of the evening, said in Switzerland they are holding one school session a day. The same is true in Holland. In addition the children are taking their vacation in the

winter time to save coal and are going to school most of the summer.

Walter S. Timmis declared that the real responsibility for the high temperatures in the home belongs to the ladies who insist on wearing summer finery in winter weather.

On his motion is was voted to have the chapter, through its officers, get in touch with the mayor and find out if the chapter could be of any assistance in preparing specific recommendations on the matter of fuel economy for general distribution throughout the city.

In connection with "standard" heating temperatures, W. L. Fleisher said that the catalogues of boiler manufactures reach a greater proportion of the general public than is reached by heating engineers and that such catalogues invariably give the 70° indoor standard. He thought one of the first steps should be to induce the boiler manufacturers to change the wording of their catalogues.

Before adjournment it was announced that the December meeting would be devoted to high temperature drying.

It was also announced that a series of lectures on heating and ventilation is being conducted at the Bronx Y. M. C. A. on Wednesday evenings, beginning December 5.

New Publication.

AN INVESTIGATION OF PIPE CORROSION is the title of Bulletin No. 30, issued by the A. M. Byers Co., Pittsburgh, Pa. The investigation was prompted by local agitation on the part of property owners who charged that chemicals were being used in the water filtration plants which destroyed the piping to such an extent that not even brass was immune. This subject was taken up by the Pittsburgh Board of Trade, and a report rendered which showed that no chemicals were used which could in any way be held responsible for the trouble, but the thought was expressed that the city should not be held responsible for the fact that much pipe of inferior quality had come into use in recent years.

In order to determine the life of pipe under varying conditions of service, Thomas F. Payne, a sanitary engineer, of Pittsburgh, was commissioned by the A. M. Byers Company to make a house-to-house canvass of buildings, "with a view to ascertaining all the pertinent facts which might aid property owners in meeting the rust question in the most efficient manner." After several unsuccessful atempts to obtain accurate data from private residences and other buildings, it appeared that apartment buildings offered the best field for investigation, and 125 such buildings, all in Pittsburgh, were investigated. A tabular statement gives the name and location of each apartment building investigated, the year of its erection, the length of time which both hot and cold water lines of brass, steel and wrought iron had been in service, where rusted out and their present condition where still in service.

The investigation showed the corrosion to be most severe in hot water mains (exposed basement piping) and the recommendation is therefore made that pipe one size larger than that used in regular practice be used. The larger size, having a greater thickness and larger bore, would not so easily rust through or become stopped with rust.

The hot water risers, which are usually concealed, proved to have a much longer life than the basement mains. It is therefore a question whether the practice of specifying brass pipe for risers, and iron or steel for mains, might not better be reversed. Brass pipe in this investigation did not show up as well as might be expected, and many complaints were heard on that account.

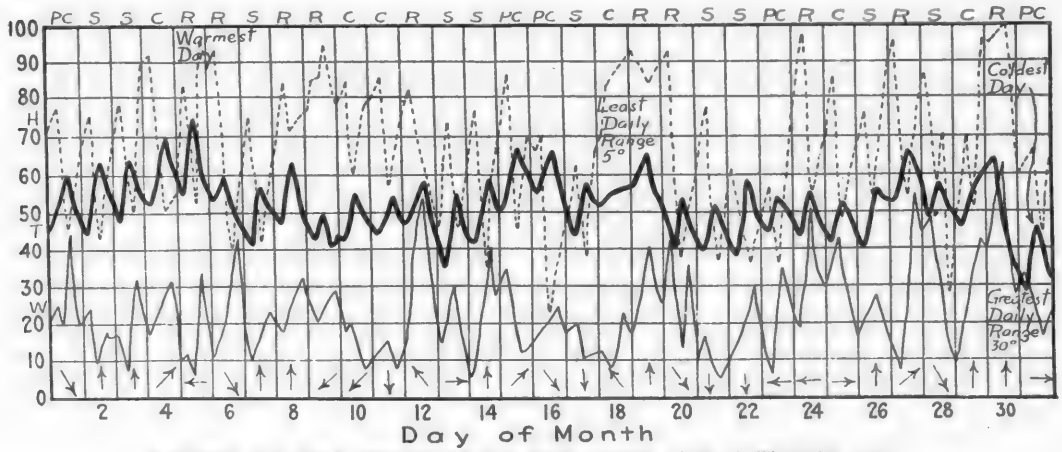
Genuine wrought-iron pipe, in 65 buildings, ranging in age from 8 to 20 years, did not show a single failure when used for cold water supply, and in only one or two of these buildings did the wrought-iron hot water risers require any repairs in the same period of time. Lead pipe, for hot water risers, seem to have an average life of 18 years, one complete failure being recorded after 14 years' service.

It appeared from the investigation that the pipe lasted a little longer where an automatic water heater was used. This undoubtedly is due to the possibility of maintaining a lower temperature of the water than with a heater not having a thermostatic control, for corrosion increases with the temperature, reaching its maximum between 140° and 170° F. Temperatures from 115° to 130° F. are therefore to be recommended wherever they will serve the purpose.

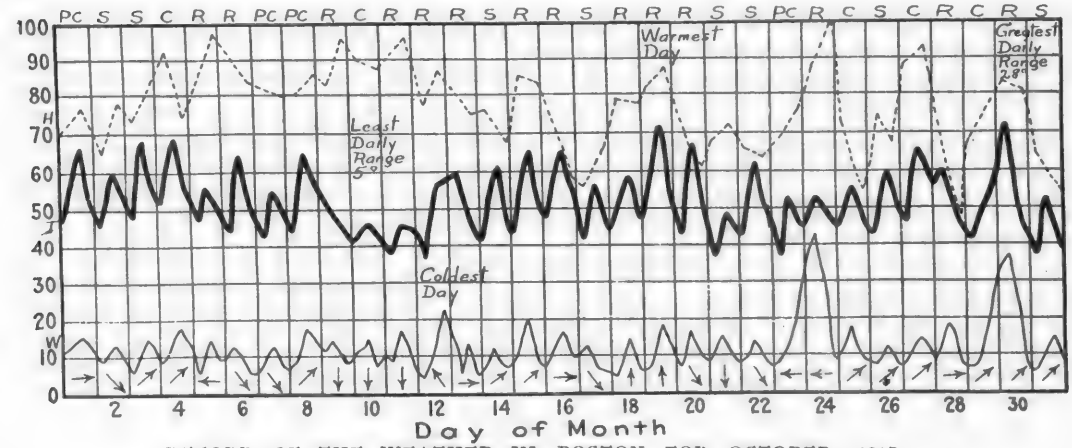
The rusting out of pipes is one of the prolific sources of trouble for the heating engineer and he will welcome any research work on this subject. A copy of the complete report can be obtained from the A. M. Byers Company by asking for Bulletin No. 30.

The Weather for October, 1917

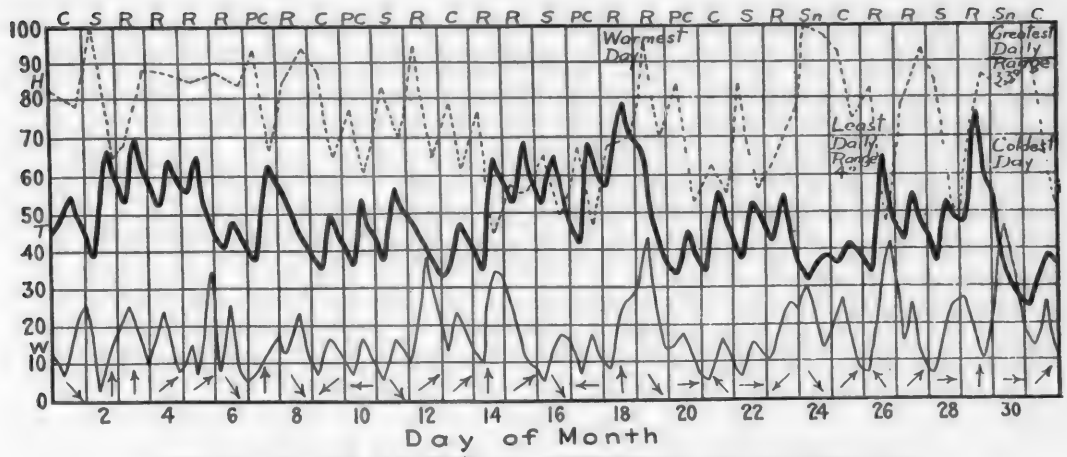
	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, degrees F.	74	71	79	69	85
Date of highest temperature	5	19	18	18	15
Lowest temperature, degrees F.	29	37	26	23	25
Date of lowest temperature	31	12	30	30	30
Greatest daily range, degrees F.	30	28	33	29	34
Date of greatest daily range	30	30	30	28	18
Least daily range, degrees F.	5	5	4	4	10
Date of least daily range	18	10	25	24	24
Normal temp. for month, degrees F.	52	52	49	45	51.1
Normal mean temp. for month, deg. F.	55.6	52.3	54.9	53.2	58.4
Total rainfall, in.	5.68	5.33	5.27	3.96	1.87
Total snowfall, in.	——	Trace	4.3	1.3	Trace
Normal precipitation, this month, in.	3.71	3.86	2.36	2.55	2.41
Total wind movement, miles	13791	8108	8849	9679	11227
Average hourly wind velocity, miles	18.4	10.9	11.9	13	15.1
Prevailing direction of wind	N.W.	S. W.	S. W.	W.	S.
Number of clear days	10	11	5	5	7
Number of partly cloudy days	8	6	7	5	14
Number of cloudy days	13	14	19	21	10
Number of days on which rain fell	10	14	16	21	10
Number of days on which snow fell	——	——	2	2	——
Snow on ground at end of month, in.	——	——	None	0.5	——



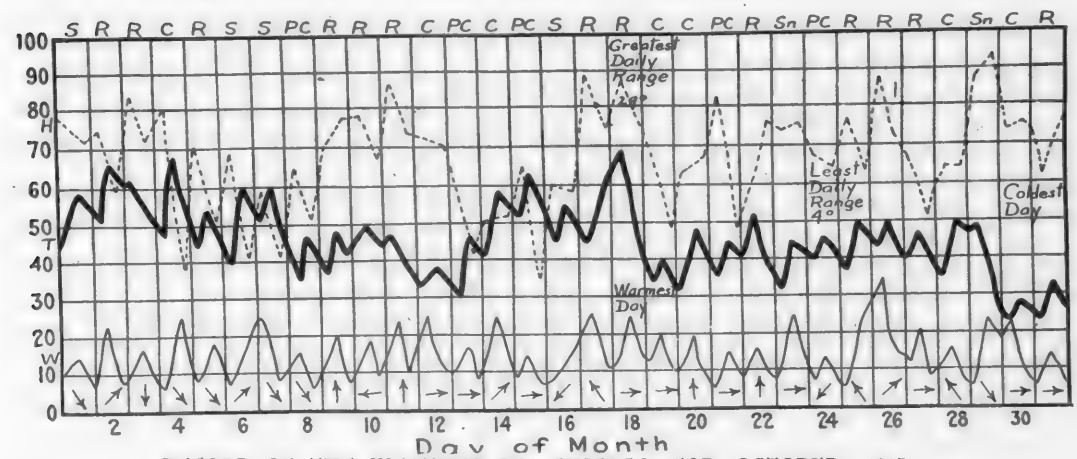
RECORD OF THE WEATHER IN NEW YORK FOR OCTOBER, 1917.
(Hourly Observations of the Relative Humidity Are Recorded on this Chart.)



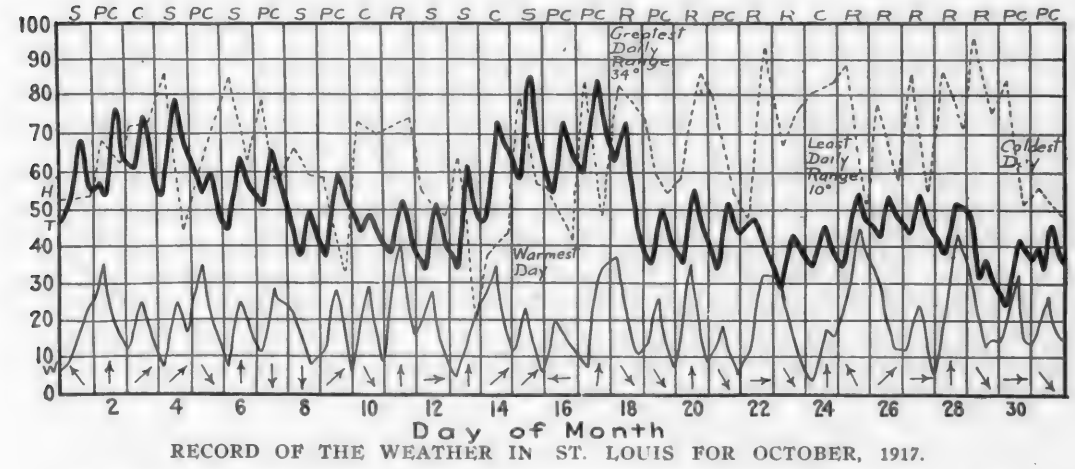
RECORD OF THE WEATHER IN BOSTON FOR OCTOBER, 1917.



RECORD OF THE WEATHER IN PITTSBURGH FOR OCTOBER, 1917.



RECORD OF THE WEATHER IN CHICAGO FOR OCTOBER, 1917.



RECORD OF THE WEATHER IN ST. LOUIS FOR OCTOBER, 1917.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.

Heavy lines indicate temperature in degrees F.

Light lines indicate wind in miles per hour.

Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.

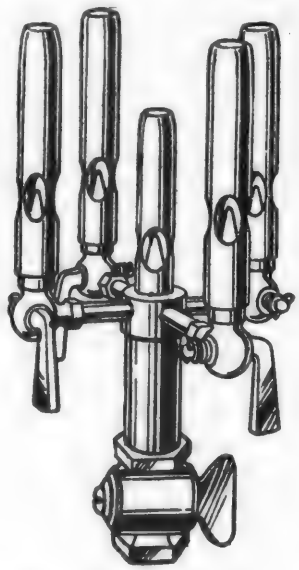
S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.

Arrows fly with prevailing direction of wind.

Trade Literature.

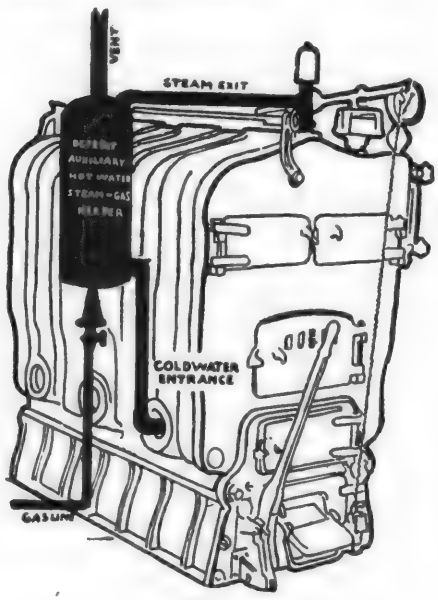
MARVEL TEMPERATURE REGULATORS and other thermostatic control apparatus are brought to the attention of the trade in a new catalogue issued by the American Thermostat Co., Newark, N. J. These devices are featured as all electric and all automatic, doing away with piping, air pumps and compressors, liquid or diaphragm action and having no springs or weights. The Marvel regulators consist primarily of a thermostat and motor, operating in conjunction and using electricity as its immediate source of power. The motor is of the automatic, electric type, using either battery, or A. C. or D. C., 110-volt current, without the intervention or use of transformer of other voltage reducing device. Illustrations show the Marvel regulators as applied for district heating service, gas heater control, steam boiler control and gas and steam control. The device is made in various models, with and without time attachement. Size of catalogue 6 x 9 in. (standard). Pp. 24.

DETROIT GAS AUXILIARY HOUSE HEATER, for use on either hot water or steam boilers, is an interesting device described in newly-issued circular matter received from the Detroit Heater Corporation, Adelaide Street and Woodward Avenue, Detroit, Mich. This device, it is stated, is capable of handling from 400 to 500 sq. ft. of radiation. The heater is built of flanged steel and tested to 50 lbs. pressure. The tubes and plates of cold drawn steel, are autogenously welded into a one-piece heater. It is 30 in. high, 8 in. wide and weighs about 40 lbs. The pipe connections are 1½ in., both ways. Special attention is called to the burner and it is pointed out how a heater may be ruined by a poor gas burner, due mainly to carbon deposits. The Detroit burner, it is stated, has the pressure and forms a highly-oxidized, hard green flame of intense heat. It is made of cold-drawn machined steel, rust-proof. Each bunsen burns 33 cu. ft. of gas per hour, with separate shut-off. The inner short tube burns 15 cu. ft. per hour and is controlled by a main gas valve and also acts as igniter for the others. Secondary air is admitted to the fire chamber by an air diaphragm. The heater complete, with burner, is listed at $75.00 and it is estimated the installation cost will be $10.00.



BURNER USED WITH DETROIT GAS AUXILIARY HOUSE HEATER.

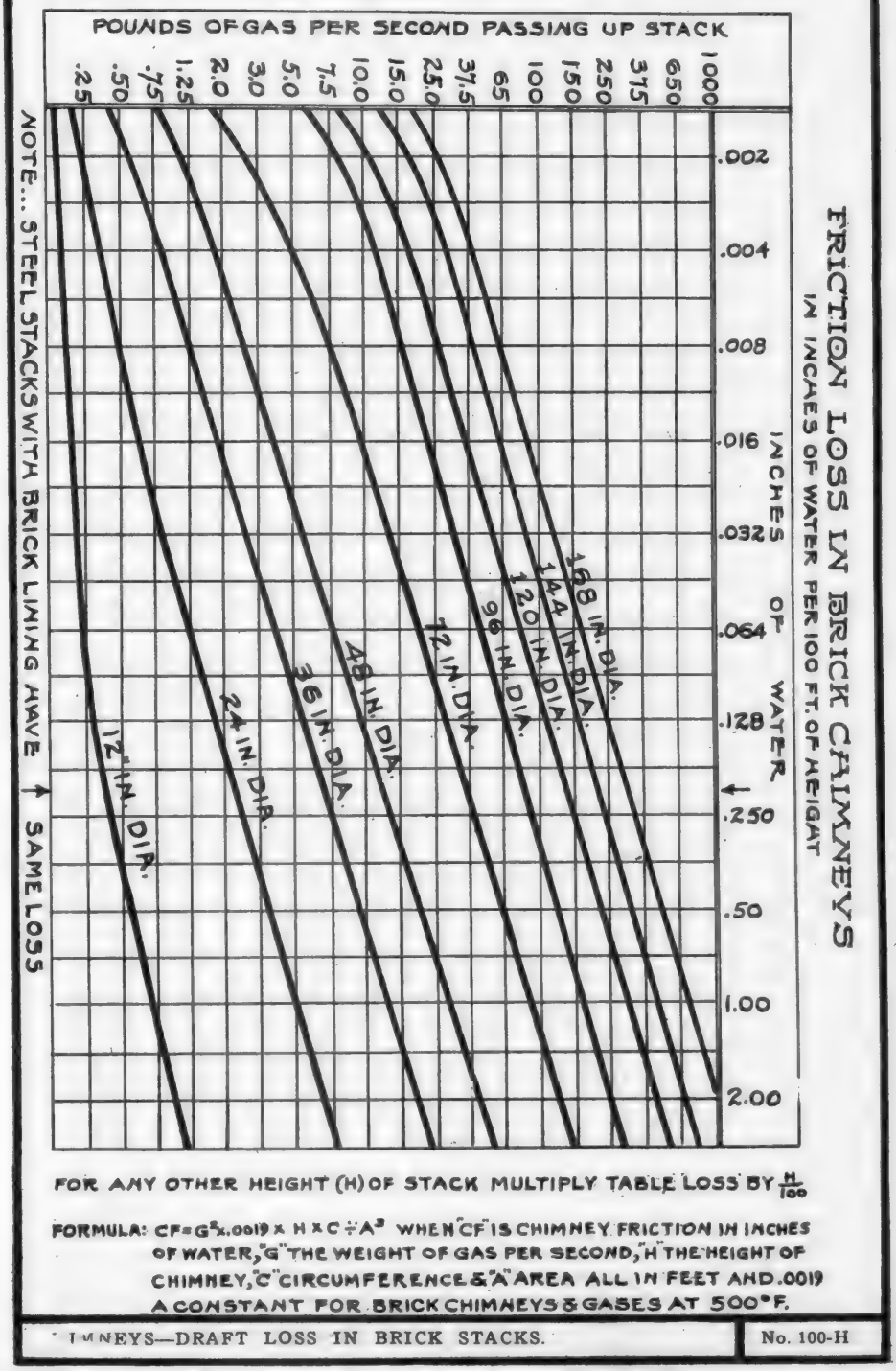
PHONE CHERRY 1656-J



STEAM
EASILY CONNECTED

DETROIT GAS AUXILIARY HOUSE HEATER.

HYDRO PRESSURE AND DRAFT RECORDERS are illustrated and described in a new catalogue (D) received from the Bacharach Industrial Instrument Co., Pitsburgh, Pa. Besides explaining the design and construction of these recorders, this pamphlet shows the different types of the Hydro draft and pressure recorders, together with the many uses and applications in the different fields of industry. Size 6 x 9 (standard). Pp. 8.



FRICTION LOSS IN BRICK CHIMNEYS

IN INCHES OF WATER PER 100 FT. OF HEIGAT

FOR ANY OTHER HEIGHT (H) OF STACK MULTIPLY TABLE LOSS BY $\frac{H}{100}$

FORMULA: $CF = G^2 \times .0019 \times H \times C \div A^3$ WHEN "CF" IS CHIMNEY FRICTION IN INCHES OF WATER, "G" THE WEIGHT OF GAS PER SECOND, "H" THE HEIGHT OF CHIMNEY, "C" CIRCUMFERENCE & "A" AREA ALL IN FEET AND .0019 A CONSTANT FOR BRICK CHIMNEYS & GASES AT 500° F.

IMNEYS—DRAFT LOSS IN BRICK STACKS. | No. 100-H

Chimneys

To summarize:

(*a*) Add together all friction losses (including those of the fire, boiler, breeching, turns, etc.) and allow 0.20 in. for chimney loss and 0.10 in. for safety. The result being the theoretical draft required to overcome all such losses.

(*b*) Read the required height of stack from the table of theoretical draft, using the line of proper elevation above sea level.

(*c*) Modify the loss in stack of 0.20 in. per hundred feet to suit the theoretical height found. Thus, for a theoretical draft requiring a stack 150 ft. high the 0.20 loss would become $0.20 \times \frac{150}{100} = 0.03$ and a new height must be re-read to offset the added friction.

(*d*) Read the diameter for brick or steel stacks on the basis of pounds of air per second handled and increase *area*—for heights above sea level—by percentage for increase of air volume.

NOTE: Measurement of the draft in a chimney is made by a draft gauge which, in its simplest form, is nothing but a glass tube of U-shape, one end of which is connected to the base of the chimney and the other end left open to the air.

The suction or draft of the chimney will raise water placed in the tube so that the water in the leg connected to the chimney stands higher than that in the leg open to the atmosphere, this being due to the unbalancd pressure and proportional thereto. The difference in level between the two columns of water is measured in inches, this difference being termed the draft in "inches of water." Some draft gauges have the legs of the U inclined only a few degrees off the horizontal so that a rise of small amount causes a large movement horizontally along the inclined tube on which fine graduations can be read.

To take a theoretical draft reading (which is the most accurate method to pursue) see that the temperature of the flue gases is known at the time of taking the reading and that a tight damper can be closed in the smoke pipe. Connect the draft gauge to the chimney, take the flue-gas temperature and then quickly close the smoke pipe damper and read the draft gauge as soon as it reaches the highest fixed point.

For points above sea level the readings will be *less* than that shown in the table, the percentages being for

2,000 ft.	97%
4,000 ft.	94%
6,000 ft.	92%
8,000 ft.	89%
10,000 ft.	86%

Thus, a chimney 50 ft. high and at 250° F. temperature at sea level should have a draft of 0.26 in., but at 6,000 ft. elevation it should have 0.26 × 92% or 0.24 in.

Chimneys

For example, suppose a steel stack, lined, at sea level is to be designed to serve:
Six—250 H.P. boilers, with four of them in service at 50% overload in extreme weather, or six in service at normal rating.
Coal to be burned, bituminous, run-of-mine;
Breeching, steel, 75 ft. long—square—
Turns, one—90° up from boiler,
One—90° into the breeching,
One—90° towards stack and
One—90° up into stack.

Turning to Standard Data Sheet No. 100-C and assuming 5 lbs. of coal per horsepower, it is found in the columns under the heading "Pounds of Coal per Boiler H.P." and in the column under the heading "5" that 1,500 B.H.P. will require 7,500 lbs. of coal per horsepower (in the extreme left-hand column) and that the "Pounds of Air per Second" (in the extreme right-hand column) is 38.

If each boiler has 80 sq. ft. of grate surface, with six boilers in service, the total grate surface would be 6×80 sq. ft., or 480 sq. ft., but with only four in service the total grate surface would be only 4×80 sq. ft., or 320 sq. ft.

7,500 lbs. of coal $1/320 = 24$ lbs. per square foot at 150% rating.
7,500 lbs. of coal $1/480 = 16$ lbs. per square foot at 100% rating.

On Standard Data Sheet No. 100-D it is found that the fire loss for run-of-mine bituminous coal at 25 lbs. per square foot is 0.14 in. and, for 15 lbs. per square foot, 0.08 in.

The boiler loss may be assumed at 0.25 in., at full rating, or 0.40 in., at 150%.

Smoke-breeching loss totals:
$0.1 \times 75/100 = 0.075$ for straight pipe
Four bends @ $0.05 = 0.20$ for bends.

0.28 in. total for bends and breeching.
Assumed for stack, 0.2 in. per 100 ft. of height
The total draft loss is then equal at

	100% Rating Inches Water.	150% Rating Inches Water.
Fire	0.08	0.14
Boiler	0.25	0.40
Breeching	0.28	0.28
Stack	0.20	0.20
Contingencies	0.10	0.10
	0.91	1.12

From Standard Data Sheet 100-F the curve at sea level shows that the stack (for 100% rating) must be about 103 ft. high, increasing its friction loss to $0.2 \times 103/100 = 0.21$ in. making 0.92 total, requiring, possibly, 103 ft. actual height. As the stack is lined, the friction loss will be the same as a brick chimney and on Standard Data Sheet No. 100-H the point under the arrow and opposite 38 lbs. of air per second is found to be almost on the 72-in. line, this diameter of stack being correct for the 100% rating.

For 150% rating, by similar procedure, the required height of stack is found on Standard Data Sheet No. 100-F to be 127 ft. and the friction loss will be $0.2 \times 127/100 = 0.25$, or 1.17 in. making about 130 ft. height required. Since, under these conditions, the chimney friction loss is 0.25 in., by referring to Standard Data Sheet No. 100-H—opposite 38 lbs. of air per second and under 0.25 in. loss, the intersection falls on 72 in. diameter exactly. This shows that the diameter is the same in each case because, of course, the quantity of gas is the same, but the height must be increased when forcing the four boilers to 150% of their ratings.

Now suppose this stack were to be located at a point 5,000 ft. above sea level. Then the theoretical draft must be 1.12 in. as before, but, referring to Standard Data Sheet No. 100-F, it is found that 5,000 ft. requires a stack 158 ft. high. The friction loss is then $0.2 \times 158/100 = 0.31$ in. and this will increase the total friction by 0.31—0.2 or 0.11 in., making $112 + 0.11 = 1.23$ in. This re-applied to the curve shows a stack actually required 172 ft. in height

Then, with a stack friction of 0.31 in. of water, on Standard Data Sheet No. 100-H, under 0.31 in. and opposite 38 lbs. of gas per second is found a point close to the 72 in. diameter line. Reference to the table on Standard Data Sheet 100-E shows that the volume at 5,000 ft. is increased 20%. The area of a 72-in. stack is about 28 sq. ft. which, increased by 20%, is $28 + 28 \times 0.2$, or 33 sq. ft. which is about a 78-in. stack.

Chimneys

COSTS

As far as the cost of chimneys is concerned, this is a rather variable amount and depends on the material of construction, the foundation necessary, location of job, etc. The ordinary materials of construction are common red brick, radial brick, steel and concrete. Steel stacks are divided into lined and unlined or partially lined and also into self-supporting and guyed stacks. Steel is the most unstable of the materials mentioned, these stacks lasting 10 to 12 years and requiring frequent painting; they rust rapidly when not in service. Lined steel stacks have a lining of fire brick to protect them from the action and heat of the gases contained.

Brick stacks last a long time, while concrete is practically indestructible if properly erected. Radial brick chimneys are built of special radial brick which have five or six holes about 1 in. in diameter running through them vertically.

The cost of chimneys per horsepower will run about as follows for the maximum horsepower which they will handle:

Up to 100 ft. high	4 ft. to 6 ft. dia.,	$2.50	to $4.50	per H.P.
Up to 125 ft. high	6 ft. to 12 ft. dia.,	2.30	to 3.75	per H.P.
Up to 150 ft. high	8 ft. to 14 ft. dia.,	1.75	to 2.75	per H.P.
Up to 175 ft. high	10 ft. to 14 ft. dia.,	1.75	to 2.00	per H.P.
Up to 200 ft. high	12 ft. or over dia.	2.00		per H. P.

If the cost of a radial brick stack be taken as unity the comparative cost of other constructions will vary about as follows:

	Cost per Horsepower
Radial Brick	1.00
Common Red Brick	1.25
Steel,—self-supporting,—lined	1.23
Steel,—self-supporting,—partially lined	1.14
Steel,—self-supporting,—unlined	.86
Steel,—guyed, lined	1.00
Steel,—guyed, partially lined	.80
Steel,—guyed, unlined	.60

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TRADE AND MISCELLANEOUS NOTES

Coming Events.

January 22-24, 1918.—Annual meeting of The American Society of Heating and Ventilating Engineers, in New York. Headquarters at the Engineering Societies Building, 29 West 39th Street.

Miscellaneous Notes.

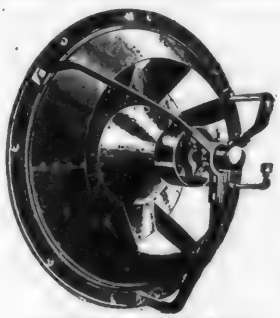
Joplin, Mo.—A vigorous campaign to enforce the ordinance regulating garage heating is to be started unless garage owners comply with orders recently issued by the city officials. It is stated that a large percentage of the garages are heated with coal although the law forbids the use of anything but steam or hot water. There are between fifteen and twenty garages in Joplin, many of them located in the business disrict where a fire might prove disastrous.

Daniel Stern, publisher of *The American Artisan*, Chicago, is recoverng from a serious illness at the Mercy Hospital, Chicago. Mr. Stern was forced to return to the hospital after he had convalesced sufficiently to be out-of-doors again.

Donald B. Prentice, instructor in mechanical engineering in the Sheffield Scientific School, Yale University, has accepted the position of assistant professor of mechnical engineering at Lafayette College, Easton, Penna.

Battle Creek Mich.—Heating the State institutions, exclusive of the Capitol, cost Michigan $436,800 last winter, according to the report of Auditor-General Fuller. Owing to the high price of coal this season, it is predicted that the cost will be double that amount. The average price for 137,155 tons of bituminous coal used last winter was $3.04, anthracite $7.44, 2422 tons being used. Coke to the amount of 310 tons was used, costing $1501.

Charles F. Hauss, a well-known American heating engineer who has been located for many years in Rome, Italy, has been



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elected president of the American Chamber of Commerce for Italy. At a dinner tendered the American military commission in Milan recently, Mr. Hauss was the toastmaster.

New Haven, Conn.—About $2,500,000 worth of new buildings are being erected at Yale University, the general contractors being Mark Eidlitz & Son, New York. The project includes ten buildings, mostly dormitories.

Building permits for October, 1917, show a total of $56,251,179 as compared with $87,692,090 for October, 1916, a decrease of 35 per cent. The details for 109 cities, as compiled by the *American Contractor,* Chicago, shows that the following cities reported increases: Baltimore 7%, Boston 62%, Lincoln, Neb., 517%; Newark 63%, Omaha 40%, Scranton 162%, and Wichita, Kan., 661%. Losses were reported from the following: Akron 37%, Atlanta 23%, Bridgeport 64%, Chicago 76%, Cincinnati 30%, Columbus 50%, Detroit 25%, Indianapolis 39%, Kansas City 51%, Louisville 74%, Milwaukee 35%, Minneapolis 37%, New York 63%, Philadelphia 50%, Rochester 30%, San Francisco 16%, Seattle 73%, St. Paul 51%, Toledo 40%, Washington 25% and Youngstown 5%.

Frank S. Hanley, New York, secretary of the Confederated Supply Association, was the recipient of a silver loving cup and a chest of silver from a number of jobbers in New York for his services in acting as secretary at their conferences. The presentation was made by L. O. Koven at a dinner at the Hotel Astor, October 18.

Central Station Heating Notes.

Seattle, Wash.—Owners of nearly 100 buildings, including the County-City Building, may be required to install new heating plants before the end of the present year if the city council passes a bill which has been recommended for passage by William Hickman Moore. The bill cancels a permit issued by the Board of Public Works to the Puget Sound Traction, Light & Power Company to install and maintain a steam main in James Street between Second and Third Avenues, and directs the corporation counsel to bring an action for trespass against the company and force it to remove its steam mains in the district between Madison and Main Streets and Third Avenue and Elliott Bay.

For Drying Operations

In drying fruits and vegetables temperature conditions *must* be correct, or results are disastrous.

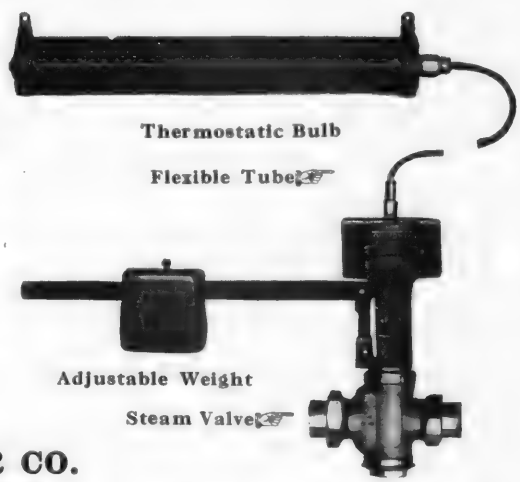
Manual control is neither accurate, reliable, nor economical.

The Powers Automatic Regulator No. 15 holds temperature *exactly* where wanted, is on the job *every minute,* reduces operating costs and increases profits.

This Regulator is used in lumber driers, varnish rooms, enameling ovens, fruit and vegetable dehydrators, sausage driers and other processes where air or vapor temperature must be accurately regulated.

Ask for Bulletin 138 for more detailed information

This Regulator is only one of the extensive Powers line. Put your temperature regulation problems up to us.



POWERS REGULATOR No. 15

THE POWERS REGULATOR CO.

Specialists in Automatic Heat Control

954 Architects Building, New York
2143 Mallers Building, Chicago
365 The Federal Street Bldg., Boston
Canadian Powers Regulator Co., Ltd., Toronto, Ont.

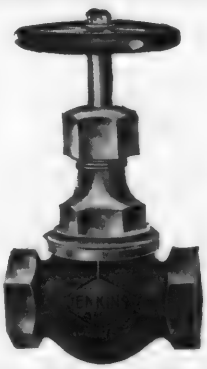
The steam heating franchise held by the company expired on February 19, 1915, and before that date the company made application for a renewal of the old or the granting of a new franchise and suggested that the amendment of other steam franchise might be made to cover the district. The matter was referred to the franchise committee, of which Councilman Erickson was chairman, with the result that every provision of a new franchise was agreed upon between council and company, with the exception of the granting by the company of rights for the city to utilize its Third Avenue lines and the Jackson Street loop for city cars, or to accept at a compensation of 1 cent transfers on all of its lines issued by the city's car lines.

The ousting of the company from the district would mean that such buildings as the American Bank, Empire, Hoge, Central, Burke, Alaska, Butler, Frye, Arctic Club, Seattle and scores of others, including the County-City Building, would be forced to install heating plants. This would cost King County Building from $30,000 to $40,000 and necessitate the excavation of another basement under the present one used in its entirety for garage purposes. The company now heats this building at a rate just one-half the lowest rate charge to other consumers for the same service, and this rate was one of the provisions contained in the franchise which the company agreed to accept with the street car provisions eliminated.

Anderson, Ind.—The Central Heating Company, of Anderson, has filed a petition with the Indiana Public Service Commission asking for a further increase in its heating rates. In September the commission granted this company an increase, based on the price of coal at that time and amounting to approximately 40 per cent more than the previous rates. This increase, however, was granted only for a temporary period covering the present heating season. In its new petition the heating company states that since the increase was granted the government has permitted an increase in the price of coal used by the company of 45 cents per ton, and has added a 3 per cent tax on the amount of freight bills paid. If the petition should be acted upon favorably by the commission, it will be made retroactive from November 1.

La Crosse, Wis.—An active fight was planned by the patrons of the heating service of the Wisconsin-Minnesota Light & Power Company, in connection with the company's petition for an increase in its heating rates from 18 to 25 cents per square foot of radiation, or an increase of 40 per cent. A hearing was held before the railroad commission November 22.

Goshen, Ind.—The municipal heating system, which has been serving private parties on North Fifth Street, announces that it



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are always sold under a guarantee of service and satisfaction. It is less expensive to maintain valves bearing for identification the Diamond Trade Mark, with interchangeable parts throughout, than to have the trouble and expense of replacing valves which have no provision for repairs.

There's a Jenkins Bros. Valve for every purpose. Include them in your specifications.

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New York Boston Philadelphia Chicago Montreal London

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Backed by thirty years of Thermometer manufacturing.

They are practically indestructible, are sensitive to changing temperatures and are very easily installed. Supplied with horizontal or vertical extension and standard pipe thread.

Ask for catalog No. 100-107 and trade prices.

STANDARD THERMOMETER COMPANY, 65 Shirley St., Boston, Mass.

Please mention THE HEATING AND VENTILATING MAGAZINE *when you write.*

will furnish no heat except to those who already have pipes connected with their residences.

Adrian, Mich.—An interesting situation has arisen in connection with the action of the Citizens' Light & Power Company in increasing its heating rates to 75 cents per 1,000 lbs. of condensation. A short time ago the company notified its patrons of the new rate. Previous to this time they were charging 45 cents per 1,000 lbs. They based their right for making this raise on the advanced price of coal, and claimed that if they advanced the price of steam in proportion to the coal, they would have charged 78½ cents.

The advanced price was called to the attention of Mayor Baker, who immediately started an investigation. Section 6 of the company's franchise, which gives it the right to operate, reads as follows: "It is hereby understood and agreed that the rates for heating herein established are relative to the cost of fuel at the present time which is $2.80 per ton of run of mine, of good bituminous coal, containing 14,000 heat units per pound, and the said Citizens' Light & Power company, its successors and assigns shall establish new rates on July 1st each year; such rates when so established to be relative to the contract price of such fuel at the time of such change. It being understood that fuel at the present time represents 70% of. the maximum rate of heating.

"The maximum rates charged under this franchise shall not exceed the following:

"For steam, 45 cents per 1,000 lbs."

Farther in the section is the following: "But the rates for heating shall vary according to the ratio above specified." Attorney Howell holds that the clause which gives the maximum rate to be charged for heating must be heeded. He holds that the other provisions are to regulate the price not to exceed 45 cents per thousand.

The city attorney's letter says:

"Replying to your request of the 9th for an opinion as to the right of the Citizens' Light and Power company of Adrian under the franchise now in force, to charge consumers of heat more than 45 cents per 1,000 lbs. of steam delivered, I would say that it appears by Section Six of the franchise in question that it was agreed that the initial rate should be based on the cost of coal at that time which was $2.80 per ton run mine coal containing 14,000 heat units

The WEBSTER System is Endorsed by Leading Architects, Consulting Engineers and Heating Contractors

The WEBSTER System is a method of circulating exhaust steam, live steam, or a combination of the two, to obtain not only the utmost efficiency, but the greatest economy.

Wasting exhaust steam, which might be put to profitable use in heating, is actually throwing money away, since all exhaust steam not so utilized requires additional live steam to be generated, at the added expense of fuel and labor, and the extra wear on the power plant

Webster **Vacuum System of Steam Heating**

has been installed in over 10,000 buildings during the past 30 years. This record has been achieved only by giving uniformly successful results.

The WEBSTER System is adapted to the heating problems of the manufacturer, whether his factory is housed in a single building or in an extended group of buildings.

Old buildings can be "Websterized," very often at comparatively little expense.

The WEBSTER System over comes "water-hammering," air-binding and excessive coal bills. Circulation of the steam is secured with little or no back pressure upon the engine. Webster Modulation Valves control the temperature in each room or department. Webster Sylphon Traps automatically discharge all air and condensation from radiators, pipe coils and drips.

Let us explain to you how the WEBSTER System will prove efficient, economical and reliable.

Write us today. Ask for Catalogue V-37

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MANUFACTURERS of Webster Systems of Steam Heating, Webster Feed Water Heaters, Webster-Leo Heater-Meters. Webster Steam and Oil Separators, Webster Steam Specialties

MAIN OFFICE AND WORKS **CAMDEN, NEW JERSEY** POINT AND PEARL STS

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DETROIT PACKLESS RADIATOR VALVES

The Correct Valve for the Beautiful Home

Detroit Packless Valves are finished with the definite purpose, that they shall harmonize with the most beautiful surroundings. In addition to their unusually pleasing appearance and smooth satin finish they are permanently efficient and will not leak or need repacking.

Booklet VP-1 Gladly Sent Upon Request

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DETROIT, U. S. A.

CANADIAN DETROIT LUBRICATION COMPANY, LTD. WALKERVILLE, ONTARIO.

LARGEST MANUFACTURERS OF RADIATOR VALVES IN THE WORLD

per pound, and it was understood that fuel represented 70% of the maximum rate for heating. It does not appear what the initial price to consumers actually was as determined by this method, but I have been informed that such rate has been for years standing at 40 cents per 1,000 lbs.

"After having fixed the initial basis of charge, the same section of the franchise, containing these words:

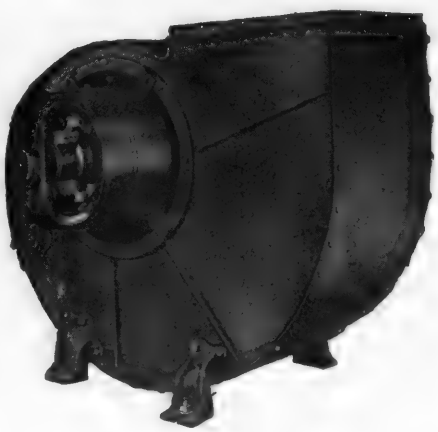
"'The maximum rates to be charged under this franchise shall not exceed the following: For steam 45 cents per 1,000 lbs.'

"The section, however, contains these words in addition:

"'But the rates for heating shall vary according to the ratio above specified.'

"If we consider that this last expression taken with the provisions in regard to price of coal, etc., gives the power company the right to fix any price whatever it may choose depending solely on the cost of coal, then the provision, fixing the maximum price to be charged has absolutely no meaning, force or effect whatever, and the words in question might have been left out.

"On the other hand, if we look at these provisions together we can say that it was the intention to secure to the consumer the benefit of possible reductions in the price



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You can be sure that it will be reliable

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The one-name plate feature is your protection

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Put Your Problems Up To Mueller Experts

Mueller makes a variety of reducing and regulating valves for water, steam, gas, air, oil and ammonia—a style to meet every demand—but different conditions require different types of valves.

To insure satisfactory service each valve must be (1) the right kind, (2) the right size, (3) properly assembled, (4) properly protected.

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meet these requirements—and when installed under our direction, are Fully Warranted and will give satisfactory service.

The Mueller corps of experts will gladly solve your special problems without charge—and will send you complete information regarding Mueller Reducing and Regulating Valves and Strainers upon request.

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of coal, without placing him in a position where the price might be arbitrarily advanced after he had put in expensive fixtures or changed his heating system on the inducement held out to him that he was assured of a rate not in excess of 45 cents per 1,000 lbs. of steam.

"If it impossible for the Citizens' Light & Power company to furnish heat on the basis agreed upon in their franchise, a showing of the facts in the case might well be made and an application for an amendment of the franchise could be made by the city commission."

Lansing, Mich.—The city council has agreed to a temporary increase in the steam heating rate proposed by the Michigan Power Company, although the higher rates were claimed to be contrary to the provisions of the franchise. The company and its patrons had come to a satisfactory understanding, however, previous to the action of the council.

Waterloo, Ia.—The raising of the steam heating rates 30% in Waterloo has resulted in an investigation to determine whether the advance is necessary. An expert was engaged to analyze the increased costs.

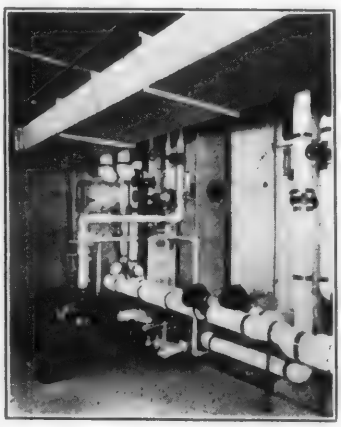
Chicago, Ill.—Six public utility companies, controlled by the Illinois Traction company, recently filed applications with the Illinois Public Utilities Commission for permission to increase their capital stock as follows: Bloomington and Normal Railway and Light Co., $53,000 preferred stock; Urbana Light, Heat and Power company, $35,000 common stock; Decatur Railway and Light company, $180,000 common stock; Danville Street Railway and Light company $49,000 common stock, Danville, Urbana and Champaign Railway company, $550,000 preferred stock; Urbana and Champaign Railway Gas and Electric company, $32,000 common stock.

Muncie, Ind.—Muncie's city council has gone on record as opposing the petition of the Muncie Electric Light company for a change in the sale of steam for heating purposes and City Attorney John McPhee was directed to appear before the Indiana Public Service Commission to oppose the petition, which asks that steam be sold on a meter basis, instead of on a flat rate basis. The principal objections to the proposed change came from residents who stated that the installation of meters would necessitate the tearing up of the piping systems in their homes. The flat rate for steam in Muncie, according to the ordinance adopted in 1902, is 25 cents per square foot of radiation for the heating season of seven months.

Webster Air Washers

For the Cleansing of Air in Connection with the Ventilation of Buildings

The Braemer System of Humidity and Temperature Control



Braemer Humidifier Installation Showing Direct Connected Pump and Motor—Automatic Control System, etc.

can be made to automatically maintain the temperature within one degree F. above or below and the relative humidity within two per cent of that for which it is set.

Air Conditioning Apparatus for Industrial Plants

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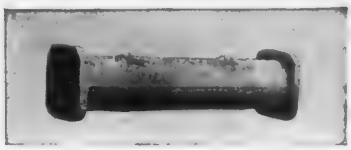
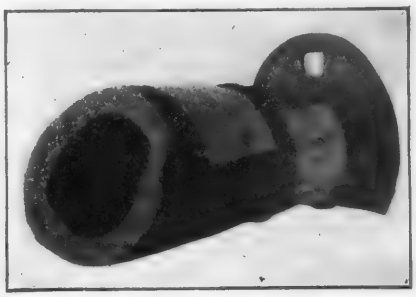
Removing One "Main Drawback"



Cast Iron Pipe 160 years old—from line s i l in service at Clermot-Ferrand, France



Cast Iron Pipe from a line 120 years old in Stolpen, Germany

Section of Cast Iron Pipe after 98 years' service in Philadelphia

"One of the main drawbacks to central heating has been the deterioration of the pipe lines."—*Central Station Heating* (Gifford) page 10.

Corrosion, the arch enemy of metal pipe, is especially active in underground installations.

It is here that cast iron pipe has proven its great superiority over all other kinds, for conveying hot or cold water, low pressure steam, gases, acids, etc.

No other pipe can approach its record of service.

THE FIRST CAST IRON PIPE EVER MADE IN THE WORLDS HISTORY IS STILL IN SERVICE
SERVICE
CAST IRON PIPE
MEASURED BY
CAST IRON PIPE
CENTURIES
MORE THAN 250 YEARS OLD

The Cast Iron Pipe Publicity Bureau

1 Broadway, New York

Manufacturers' Notes.

Parker Supply Co., New York, manufacturer of the Parker line of steel sheet-metal screws, expansion bolts, sash chains and damper quadrants, it is announced has been completely reorganized and is now backed by a $3,000,000 international concern. Much new machinery has been installed in its plant at 785 East 135th street, doubling the company's output. H. Rosenberg, well-known as an inventor, remains as president of the company.

Spencer Turbine Cleaner Co., Hartford, Conn., has received the order for the vacuum cleaner installation in the Hotel Commonwealth, New York, which is to be the largest hotel in the world. The system will consist of a central plant in the basement, with piping extensions to several hundred stations.

Bridgman Bros., Philadelphia, jobbers of heating and plumbing supplies, will move January 1 to new and larger quarters at Chestnut and 31st streets, Philadelphia.

B. F. Sturtevant Co., Hyde Park, Mass., it is reported, has prepared plans for an addition to its factory in Readville, Mass.

Joseph T. Ryerson & Son, Chicago, commemorated on November 1, the 75th anniversary of the establishment of its business. It is stated that previous to the Revolutionary War the Ryerson family owned some 6,000 acres of land in the iron district of New Jersey was the basis on which the present company was built. The company now has important plants in Chicago, Jersey City and St. Louis. The officers are: President, Clyde M. Carr; vice-president and treasurer, Joseph T. Ryerson; vice-presidents, Donald M. Ryerson and Edward L. Ryerson; second vice-president, George D. Moody; secretary and assistant treasurer, E. L. Hardy.

Harrison Safety Boiler Works, Philadelphia, Pa., announces the appointment of W. F. Trenary, Jr., as its Birmingham, Ala., representative, succeeding W. R. Jennison. The company's Birmingham branch is located at 419 Brown-Marx Building.

National Regulator Co., Chicago, announces that H. Archibald Harris has resigned the position he has held for many years of secretary and treasurer of the National Regulator Company, to accept a position December 1, with the Etching

Tycos

TEMPERATURE INSTRUMENTS

In describing *Tycos* temperature instruments we make no attempt to put a crimp in advertising's vocabulary. Behind them is a solid structure of manufacturing experience, the result is a product giving results as nearly complete as correct construction, tried by practical experience can give—full measure of service.

Surely producing more temperature instruments than any other concern on earth is evidence of our ability to serve a large and discriminating demand for a product of solid worth at all times and at a *right* price.

Let us have your address for folder "On the Trail of the Thermometer" and other literature.

Tycos Mercurial, Recording and Index Thermometers for all industrial and laboratory applications.
Electric Contact Thermometers.
Temperature, Pressure and Time Regulators.
Mercury Column Vacuum, Pressure and U Gauges.
Tycos Base Metal, Rare Metal and Radiation Pyrometers, (Indicating and Recording) Fery Radiation Pyrometers.
Hygrometers
Hydrometers.
Mineral Oil Testing Instruments.
Aneroid and Mercurial Barometers
Recording Barometers.
Pocket Compasses.
Surveying Compasses.
Rain Gauges.
Anemometers and Air Meters.
Thermographs.
Hand Levels.
Aviation Barometers.
Inclinometers.
Tycos Sphygmomanometers.
Tycos Fever Thermometers and Urinary Glassware.
Thermometers of all kinds for home and general use.

Taylor Instrument Companies

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No. 40

Sirocco

TRADE MARK

Will Put Pure Washed Air Into Every Corner of Your Factory

The Dodge Bros. (Motor Cars) Office and Plant are almost exclusively equipped with Sirocco Products.

Their fine office building, here shown, is served by the Sirocco Washed Air System Their Dining Room, Kitchen, Core Shop, Pressed Steel and Gear Shop have the healthful influence of a constant supply of fresh, properly tempered air. These departments, too, are served by Sirocco Apparatus.

Book No. 2709 illustrates many plants in which "Sirocco" Systems are used. May we send it to you?

AMERICAN BLOWER CO.

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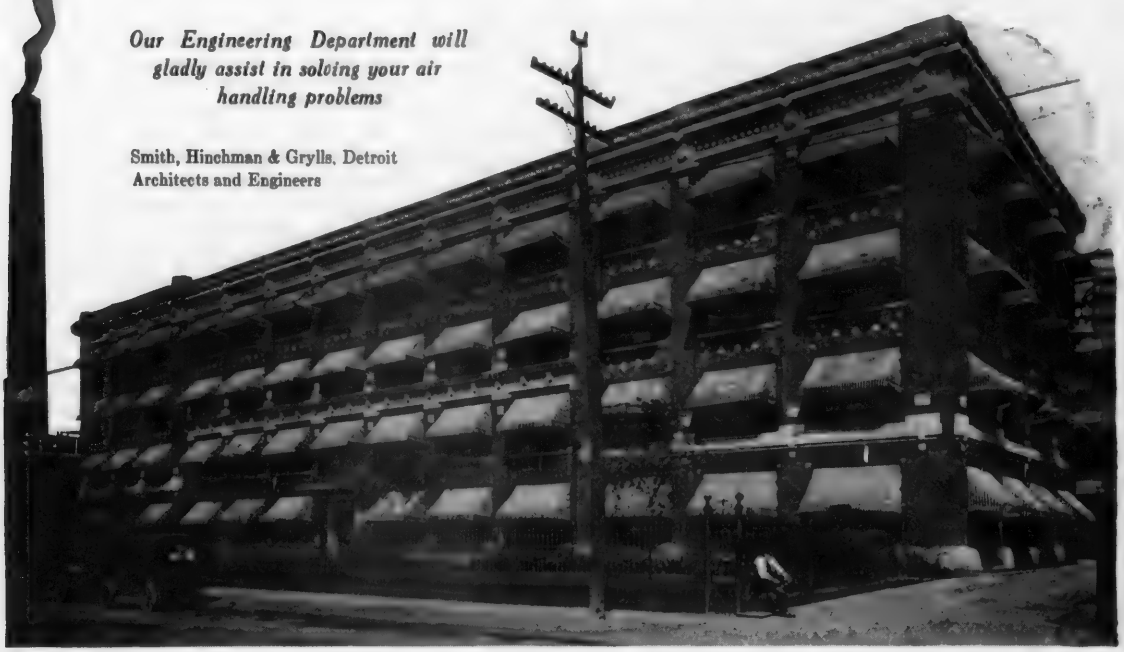
Our Engineering Department will gladly assist in solving your air handling problems

Smith, Hinchman & Grylls, Detroit
Architects and Engineers



Company of America as director and officer in control of its financial and business affairs.

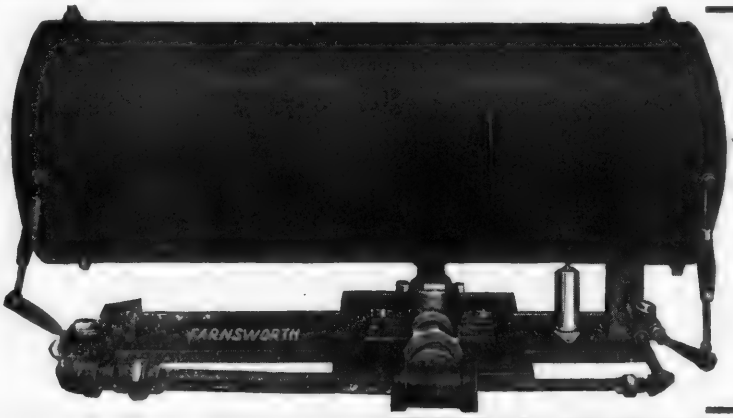
New Incorporations.

Parrott Heater Co., Detroit, Mich., capital $4,000, to manufacture gas heaters. Incorporators: J. M. Hess, Joseph McFadden, Arthur J. German.

East Fulton Hardware, Heating & Plumbing Co., East Fulton, Mich., capital $20,000. The stockholders include Harry Vander Veen, Jennie Gouan and Cornelius Van Houten.

Loring Heating Co., Superior, Wis., capital $18,000, organized to own, maintain and operate a hot water heating plant to heat the Loring Terrace, from a site next to the terrace. Incorporators: E. A. Arnold, B. C. Cooke and M. McMahon.

James T. Hunter Heating Co., Jersey City, N. J., capital $75,000. Incorporators: James T. Hunter, L. H. Hunter and Arthur T. Dear.



Condensation Pumps

7 Types

Send for catalogue and circular showing systems

FARNSWORTH CO.
Conshohocken, Pa.

RELIABLE
COMPACT
EFFICIENT

No Steel Tank to Rust Out

Buffalo Automatic Condensation Pumps

are used to handle returns to boilers in hundreds of low pressure heating systems, materially reducing fuel consumption.

40 GALLON CAST IRON RECEIVER BRASS FITTED PUMP

Specify amount of condensation, boiler pressure and details of electric current in your inquiry.

Buffalo Steam Pump Co.
Buffalo, N. Y.

Contracts Awarded.

Crowell & Smith, Cleveland, O., report an increasing number of orders for the installation of both gas-burning and coal-burning boilers designed to be used as auxiliaries and thus permit the use of either gas or coal as fuel for the same heating system. Cleveland, it is stated, faces a repetition of last winter's coal shortage.

Richards Plumbing & Heating Co., Grand Rapids, Mich., is remodeling the heating system for the Flotop Aeroplane Company at the Nelson-Matter new factory in Grand Rapids.

E. R. Schollenberger, Hamburg, Pa., heating and plumbing seven new buildings at the League Island Navy Yard, for $35,000.

Isbister Heating Co., Spokane, Wash., heating and lighting the swimming pool of the Lewis and Clark School, in Spokane.

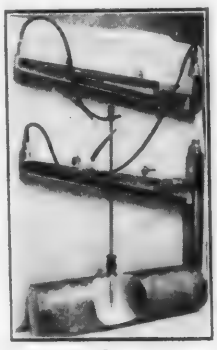
Sturges & Sturges, Portland, Ore., heating the new medical building for University of Oregon, for $12,089. Other bids were W. F. Bunce, $14,396; Kendall Heating Co., $3,897; Muirhead & Murhard, $16,900; Rushlight & Hastorf, $12,926; J. F. Shea, $13,917. Plumbing: Fullman & Walker (awarded contract) $8,297; Coffey Plumb-

Do You Know How Much Air You are Using?

A PORTABLE PITOT TUBE

Should be used to test every air line.

Easy to Use—Accurate—Inexpensive



Each instrument is individually calibrated; each tube is nickel-plated, and furnished with plush-lined box.

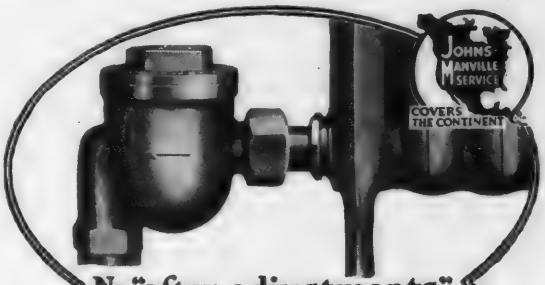
The stuffing-box prevents leakage of gas around the stem; the tube may be rotated or moved in and out, or it may be clamped in any position by tightening the stuffing-box nut. The stem is graduated to tenths of an inch. Suitable for all diameters of pipe up to 24 in.

Instruction sheet gives constants applying to all usual applications.

Prices and further information on application

A. H. ANDERSON

3300 Federal St. Chicago, Ill.



No "after adjustments" to eat up your profits

FIVE minutes to regulate a radiator trap doesn't sound very costly. But if there are 500 traps in the building, and each needs attention, then it's a week's time—and it comes right out of your profits.

That's just one of the ways you save money by installing Johns-Manville Radiator Traps. No valve or valve seat adjustments required or possible, and chances for trouble are cut to the limit. No expanding liquids, no springs, no restricted air passages; no steam leakage or air binding.

Just three parts—body, ball, and connecting union. Nothing to wear out—nothing to be tampered with. Its record in service will give you some new ideas on trap economy. Better get the details.

H. W. JOHNS-MANVILLE CO.
NEW YORK CITY

10 Factories—
Branches in 56 large Cities

Johns-Manville Radiator Trap

INSTALL THE RADIATOR TRAP

SARCO

AND GET THESE ADVANTAGES

Small—Compact and highly serviceable with lowest possible installation expense.

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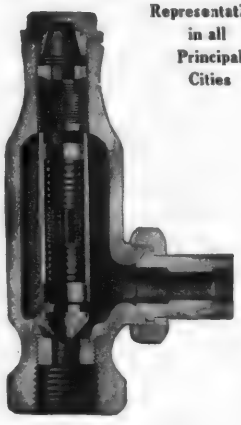
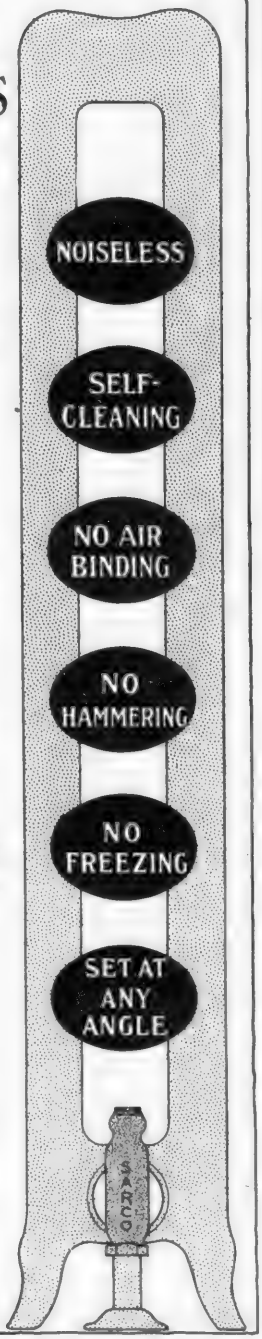
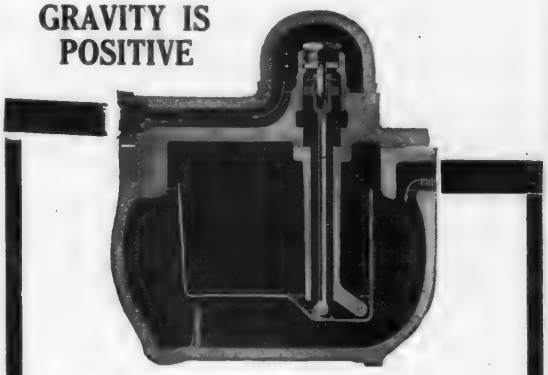
Representatives in all Principal Cities





GRAVITY IS POSITIVE



THE SWARTWOUT

Hydromatic

TRAP

1. Operates on gravity and buoyancy only.
2. Employs only two moving parts.
3. Bucket hinged inside in clear water.
4. Patented water seal.
5. All pressures up to 250 lbs. by interchange of valves.

Full specifications—free.

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9211 Detroit Ave. Cleveland, Ohio

RECOMMEND

CONNERSVILLE VACUUM CLEANERS

None too Large
None too Small

MANUFACTURED BY

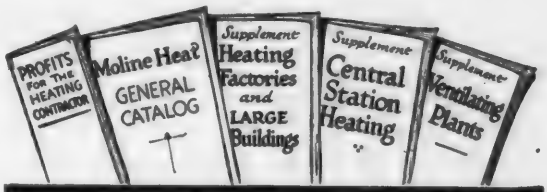
United Vacuum Appliance Co.
Connersville, Ind.

ing Co., $16,377; De Temple & Co., $8,739; Muirhead & Murhard, $10,759; Rushlight & Hastorf, $8,941; G. F. Shea, $8,990; Sturges & Sturges, $8,500. All were Portland bidders. A steam heating plant will be installed. The structure will be two stories, 60x200 feet.

L. F. Hamilton Now Identified with Walworth Manufacturing Company.

L. F. Hamilton, for the past nine years manager of the advertising and specialty department of the National Tube Co., Pittsburgh, has resigned his position to take up approximately the same kind of duties with the Walworth Mfg. Co., Boston. This is the company which purchased the Kewanee works from the National Tube Company last August. Mr. Hamilton will specialize in exploiting the Kewanee products, having been closely identified with the advertising success of the Kewanee union, as well as of the Shelby tubing and National pipe. His new duties will be more particularly the training of specialty agents, supervision of specialty and sales promotion work, etc.

W. L. Schaeffer, who has been Mr. Hamilton's assistant, will assume the position of advertising manager for the National Tube Company.



THESE VALUABLE BOOKS *FREE!*

Each one is worth big money to you. Every heating contractor should have them. They cover all the latest money-making ideas in figuring and installing steam heat—hot water heat—vapor heat—and vacuum systems.

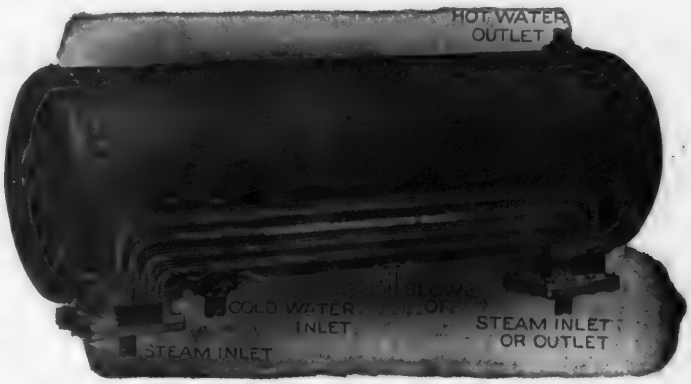
These books will help you to land more orders and increase your profit on every job. Write for them at once. They are absolutely *FREE!*

Moline Illinois

THE ⌐¬ SHAPE TUBES EXPLAIN THE SUCCESS of the

PATTERSON HOT WATER TANK

for heating water for domestic or manufacturing purposes. Both ends of each seamless brass tube are expanded into heavy cast-iron tube-heads with an improved roller expander. Their shape provides for the free contraction and expansion of each individual tube without straining, so there is no danger of leakage.



Type C. Patented Aug. 26, 1913.

Any Combination of Storage and Heating Capacities can be Furnished. Send for Catalogue.

PATTERSON - KELLEY CO., 23 Dye Street, New York

Representatives in all Principal Cities.

at the sign of good heating
INTERNATIONAL
BOILERS & FURNACES

THE
INTERNATIONAL ECONOMY
ROUND BOILER

THIS new INTERNATIONAL Boiler is a "corker." You cannot judge this by a mere glance at the illustration; you have to understand how it is *designed*.

Every feature that makes for boiler efficiency has been carefully considered by our engineers and worked into this boiler after a series of scientific and practical tests extending over a period of more than two years.

The positive cross fire travel is one of its distinctive features; the heated gases impinge against every square inch of heating surface and short circuiting is impossible—there are no soot pockets and all flue surfaces are readily accessible for cleaning.

A Post Card Request will Bring Catalog or Salesman to Explain—Whichever You Desire.

INTERNATIONAL HEATER COMPANY
UTICA, N. Y.

CHICAGO
1933-35 Wentworth Ave.

NASHUA, N. H., 3 Middle St

NEW YORK
601 West 27th Street

Johnson { Heat / Humidity } Control

Always the Leader in Inventions and Improvements

First: Practical Heat Regulation.

Second: Pneumatic Thermostats.

Third: Humidostats—the first practical apparatus for the control of humidity.

Fourth: The "SYLPHON" Metal Diaphragm Valve for heat control, the one thing needed to make heat regulating systems durable and reliable. We tested this valve three years before we offered it for use. Untested imitations and substitutes followed fast, but having been thoroughly tested and proven equal to all demands.

the "SYLPHON" is the Recognized Standard.

Fifth: Unequalled Service in all Departments.

Johnson Service Company
Milwaukee, Wis.
Offices in all Large Cities

Please mention THE HEATING AND VENTILATING MAGAZINE *when you write.*

THE SIGNIFICANCE TO *YOU* OF THE MEMBERSHIP OF THE

The Heating and Ventilating Magazine

IN THE ASSOCIATED BUSINESS PAPERS, INC.

YOU depend upon The Heating and Ventilating Magazine for an unbiased and accurate report of all news affecting your business interests.

Probably too, you give heed to its editorial counsel in many matters of considerable consequence. You have a right therefore, to know about the policies and principles back of the important service rendered by The Heating and Ventilating Magazine.

The membership of this publication in the Associated Business Papers, Inc., (the International Association of Class, Trade and Technical Papers), means that it has achieved an exceptionally high publishing standard, and has subscribed unreservedly to these—

STANDARDS OF PRACTICE OF BUSINESS PAPERS

The publisher of a business paper should dedicate his best efforts to the cause of Business and Social Service, and to this end should pledge himself.

1. To consider first the interests of the subscriber.

2. To subscribe to and work for truth and honesty in all departments.

3. To eliminate, in so far as possible, his personal opinions from his news columns, but to be a leader of thought in his editorial columns, and to make his criticisms constructive.

4. To refuse to publish "puffs," free reading notices or paid "write-ups;" to keep his reading columns independent of advertising considerations, and to measure all news by this standard: "Is it real news?"

5. To decline any advertisement which has a tendency to mislead or which does not conform to business integrity.

6. To solicit subscriptions and advertising solely upon the merits of the publication.

7. To supply advertisers with full information regarding character and extent of circulation, including detailed circulation statements, subject to proper and authentic verification.

8. To co-operate with all organizations and individuals engaged in creative advertising work.

9. To avoid unfair competition.

10. To determine what is the highest and largest function of the field which he serves, and then to strive in every legitimate way to promote that function.

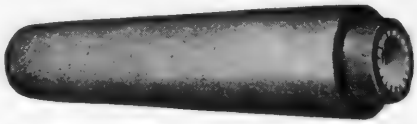
If you have read the foregoing standards, there is not much left to be said, except to tell you that these principles are ***present day realities*** and not merely beautiful ideals for future attainment.

THE ASSOCIATED BUSINESS PAPERS, Inc.

The International Association of Trade, Technical and Class Publications

220 WEST 42nd STREET NEW YORK CITY

STANDARD
Steam Pipe Casing



For Insulating Underground Steam Pipe. Tin Lined, or Unlined.

Every salesman has his argument in order to sell the product he represents. Listen to our argument, be the judge, and you will find same not theoretical but practical, and from actual experience.

When you cover your steam line with our make of casing you have the assurance that the line will be constructed so that no heat will escape, and will be water tight as well, with ample space for air chamber.

Should occasion arise that it is necessary to get at the steam pipe, our covering CAN BE TAKEN APART WITHOUT DESTROYING THE STAVES in the sections of casing, and the same casing can be used again. LET US EXPLAIN HOW.

If your line runs in different branches we will build the casing in exact lengths so that you will not have to cut any sections, which means no waste or extra expense to you.

Our method of building covering will be to your interest. Our product is right, attention prompt, and prices low.

SEND FOR BOOKLET

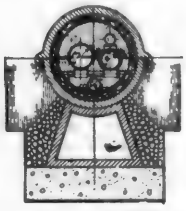
Standard Wood Pipe Co.
WILLIAMSPORT, PA.

MANUFACTURERS OF
Equipment and Supplies
FOR
Central Station Heating Plants

Copper Diaphragm Expansion Joints, Slip Joints, Anchor Crosses, Line Anchors, Collars, Manhole-Curbs, Pipe Guides, and The Detroit Condensation Meter

THE DETROIT FEED WATER METER

Central Station Steam Co., Detroit, Mich.



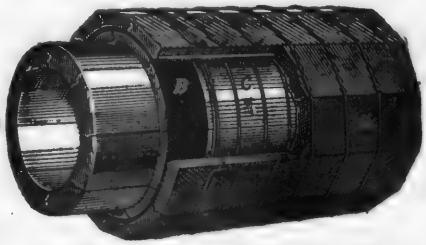
RIC-WIL METHOD

OF

Insulating Underground Steam and Hot Water Pipes

Send for Catalogue

THE RIC-WIL COMPANY
CLEVELAND



A—Inner Shell, 2 inches thick.
B—Asphaltum Packing.
C—Dead Air Space.
D—Outer Shell, 1 inch thick.

Cover Your Steam Pipes

WITH WYCKOFF'S IMPROVED

CYPRESS COVERING

Made of Gulf Cypress, the wood eternal

Not affected by wet and dry conditions common to steam-pipe trenches. Will not rot. Lasts twice as long as Pine Casing. Absolutely water and steam tight. Each shell is wound with heavy galvanized wire. Coated all over with the best known preservative—Hydrolene B.

Let us answer your questions and tell you all about it. Booklet on request.

A. WYCKOFF & SON COMPANY
ELMIRA . . N. Y.

Atlanta, Ga.: 378 Piedmont Ave.

We Ask You to Be the Judge

Most steam radiators look alike to some contractors who do not make an investigation, but buy the first one they can lay their hands on. Now, this is no way to buy anything, particularly steam valves.

'Tis well to investigate thoroughly and be sure. When you set such an investigation on foot, we ask you to put

LAVIGNE

Packless Quick-Opening Steam Radiator Valve

at the head of the list and compare them critically, point by point, with any and all others. We are not afraid of comparison—in fact, we court it, for we know that such a comparison will lead to its choice.

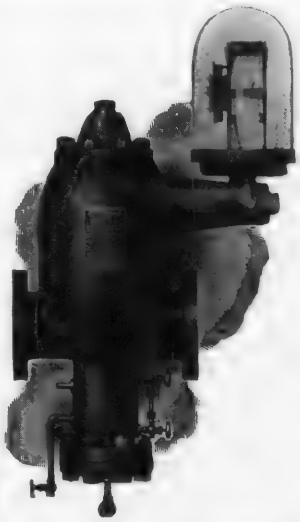
You will do well to specify, install and use the valve that's

BUILT RIGHT TO STAY TIGHT

Ask your jobber

LAVIGNE MANUFACTURING COMPANY

Detroit, Michigan



Know Your Costs

Do you know how much steam is being used in your Plant, also how much is used by the different departments? Write today for bulletin No. 146, "The New Straight-Way St. John Meter". It will enable you to "know your costs" for Power, Heating, Cooking, Drying, etc., etc.

AMERICAN DISTRICT STEAM COMPANY

General Offices and Works:
NORTH TONAWANDA, N. Y.

NEW YORK CHICAGO SEATTLE

"ECONOMY"
AUTOMATIC ELECTRIC
Cellar Drainers

Small Power
Large Capacity
Perfect Workmanship
Highest Quality Materials

Rock Bottom Prices Made Possible by Quantity Production

Economy Pumping Machinery Co.
112-118 North Carpenter St., Chicago Ill.

If You Have Not a Set of Our Catalogs, Get It Today

Thermometers for all applications

GAUGES

Steam, Vacuum Compound, Altitude, etc.

It is more than a catalog—it is a text book on Instruments for Indicating and Reading Pressure, Vacuum Draft, Temperature, etc.

Write for Special Catalog Set HV Today

The Schaeffer & Budenberg Mfg. Co.
BROOKLYN, N. Y.

Chicago Pittsburgh Washington
St. Louis Philadelphia Los Angeles

Also many other Allied Instruments, Gauge Boards and Complete Equipment

STATEN'S HIGH-EFFICIENCY SECTIONAL STEAM CONDUIT

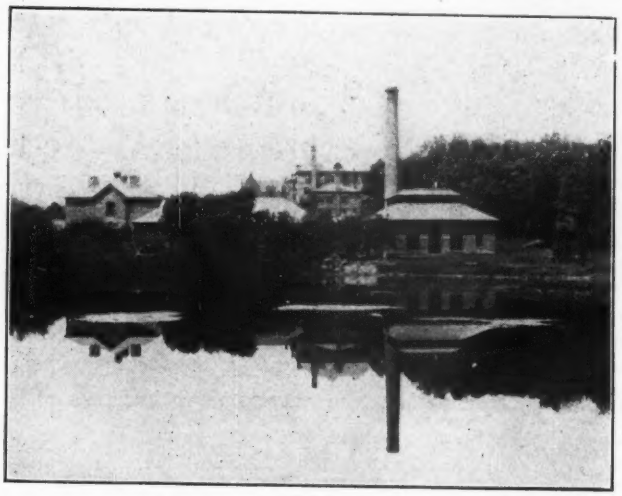
HAS BEEN ADOPTED FOR

U. S. Government Work

(See news item on page 52)

Staten's Sectional Steam Conduit is thoroughly salt-glazed tile especially made up in half sections, with roll-frame pipe supports and special conduit insulation, installed complete, ready for steam pipes, by us.

Complete specifications for installing Staten's High-Efficiency Sectional Conduit and Estimates of Cost furnished upon request.



Staten's "H.-E." Sectional Steam Conduit is Especially Adapted for Central Heating Plants

UNDERGROUND SPECIALTY CO., 1476 Broadway, New York

We are also agents for Wyckoff Improved Cypress Casing

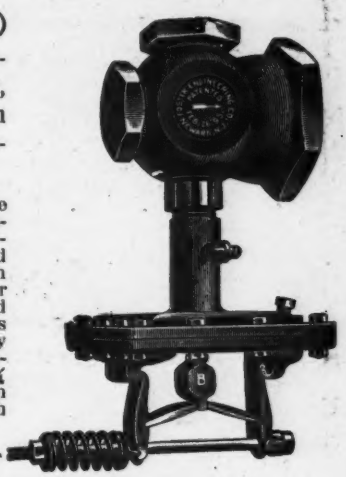
For Safety, Sureness of Operation and Durability

FOSTER PRESSURE REGULATORS

for STEAM HEATING SERVICE

(Classes "Q" and "Q H") lead the way. Designed especially for steam heating, and suitable for vacuum systems, for delivery pressure of from 1 to 15 lbs.

We make several types of pressure regulators—those shown in the illustrations here were designed particularly for steam heating service, and they are very sensitive, reliable, high grade in every particular and superior to other makes in construction and workmanship. there are no weights or close fitting pistons, and are easily adjusted to the desired pressure between 1 and 15 lbs. Made in sizes ¾ inch to 2 inches inclusive, composition body. Larger sizes are fitted with composition renewable seats.

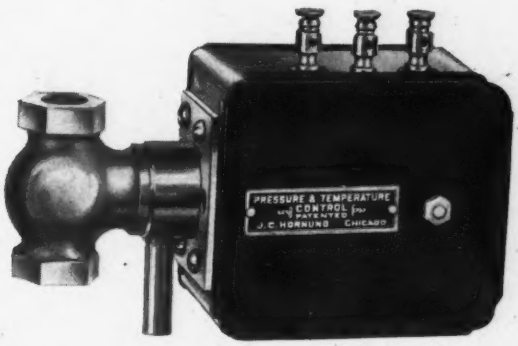


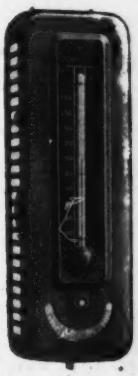
Class "Q" Class "Q H"

These Valves are fully explained on Pages 29 to 33 of our General Catalogue, No. 20.

FOSTER ENGINEERING CO., Newark, N. J.

CHICAGO, ILL., 189 North Dearborn Street
PITTSBURGH, PA., 518 Park Building
PHILADELPHIA, PA., 601 Harrison Building
BOSTON, MASS., 161 Summer Street





CONTROL *of* PRESSURES *and* TEMPERATURES *on* CENTRAL HEAT

is the ONLY WAY to compensate for the HIGH COST of production.

The HORNUNG MAGNETIC CONTROL

is designed to meet the above situation and a thousand others.

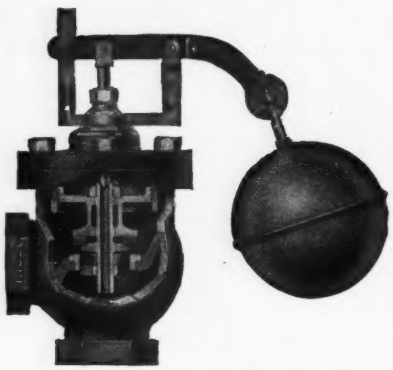
A request for circular, mailed today, will bring good returns

CENTRAL HEAT APPLIANCES

J. C. HORNUNG

343 South Dearborn Street **CHICAGO**

DAVIS VALVES



Davis Float Valve

THE little things that come under your care often give you the greatest annoyance when they go wrong.

You can safely put your faith in a Davis Float Valve. It was designed to operate without trouble and it works as intended.

It has a single seated renewable composition disc—it is tight when closed.

The expense and annoyance of fooling with a leather cup packing is entirely eliminated—only the stem is packed.

Try one of these valves at our risk. Globe and angle patterns.

We make Pressure Regulators, Balanced Valve, Float Valve, Steam Trap, Back Pressure Valve, Exhaust Relief Valves, Stop and Check Valves, Pump Governors, Damper Regulator, Radiator Air Valves, Emergency Stop Valve.

G. M. Davis Regulator Compar

436 Milwaukee Ave., Chicago

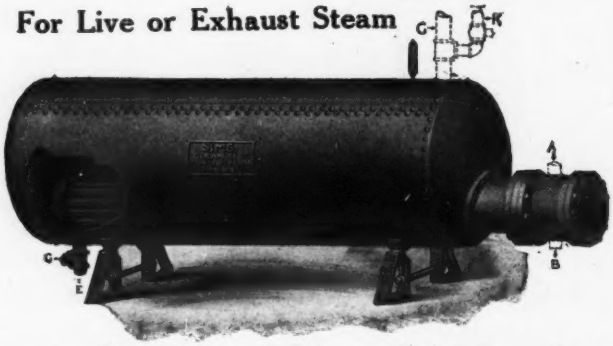
New York, 123 Liberty — Boston, 70 High — Philadelphia, 2218 Vine — The Hartje Bldg., in Pittsburgh — Calvert in Baltimore and Rialto in San Francisco.

Valve Specialty Manufacturers Since 1875

Sims Clean E-Z Steam Tube Heater

For Hotels, Apartment Buildings, Hospitals, Y. M. C. A. Buildings, Schools, etc.

For Live or Exhaust Steam



requiring large quantities of hot water. This type of heater should be used in preference to circulating generator and storage tank—or instantaneous heaters.

Special attention given to all kinds of water heating problems based on long experience in this work.

Valuable tables have been prepared, showing heater capacities using steam at various pressures. These tables are yours for the asking.

THE SIMS CO., 18th St., Erie, Pa.